VETERINARY STUDIES FOR AGRICULTURAL STUDENTS

M. H. REYNOLDS

VETERINARY STUDIES

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FOR

AGRICULTURAL STUDENTS

BY

M. H. REYNOLDS, B.S.A., D.V.M., M.D.

PROFESSOR OF VETERINARY MEDICINE, UNIVERSITY OF MINNESOTA; MEMBER INTERNATIONAL COMMISSION ON CONTROL OF BOVINE TUBERCULOSIS; MEMBER AMERICAN VETERINARY MEDICAL ASSOCIATION; MEMBER AMERICAN MEDICAL ASSOCIATION; MEMBER AMERICAN PUBLIC HEALTH ASSOCIATION; ETC.

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PREFACE TO FIRST EDITION

During ten years experience in teaching veterinary subjects to agricultural students, certain difficulties have been constantly encountered. Others doing this work have probably had similar experience. There has been the difficulty of imperfect training, or entire lack of training, in physiology and other subjects which medical men recognize as fundamental. There is always present the difficulty of presenting a technical subject in untechnical language; difficulty in securing satisfactory illustrations; and difficulty in giving the kind and character of veterinary work which is generally demanded and conceded as necessary, without giving our students a sort of training which will turn some of them into unqualified practitioners. There has been serious difficulty in covering, without a textbook, a satisfactory amount of ground. Many students do not take notes well, and hence for several years I have been distributing mimeographed lecture notes to my classes.

During this time I have been more and more impressed with the belief that a textbook, wisely illustrated and carefully edited for its legitimate use, would enable me to cover very much more ground within the available time.

The style of editing that has been adopted was selected with a view to presenting the subject matter to students in a conspicuous and easily grasped way. This must be our excuse and answer to criticism which the expert printer may legitimately make.

This work has been written more particularly as a text for veterinary classes in agricultural colleges; but it is

hoped that it may prove helpful also to stockmen who are not able to attend our agricultural colleges, but who care to know more of the animal machines with which they are working. I take this occasion to deprecate the blind home dosing of stock to which farmers and stockmen are very much inclined. The student should realize the impossibility of writing a prescription that will fit all cases of a certain disease, and if a good student he will hesitate to risk the use of medicines of which he knows very little in diseases of which he knows less.

Lecture notes which have been collected during a period of ten years have formed the basis for this work, and I am now unable, in many cases, to give credit to authorities that have been consulted, where credit is fairly due.

Illustrations have not been used in any case merely as pictures. Every one is intended to illustrate something and make that illustration as impressive as possible.

Suggestions to the teacher. It is not intended that this, as a textbook, should entirely supplant the lecture work. On the contrary, nearly every lecture may be supplemented to advantage and so give opportunity for originality and the greatest effectiveness. It will be readily understood that certain subjects are of very great importance in some states, and unimportant in others. Each teacher should add what he thinks best for his grade of pupils and his local needs.

When time permits much time can be profitably spent on more extended anatomy work, especially for students who wish advanced live stock work. It can be readily illustrated and easily impressed: for instance, that smooth or rough hips depend upon a fraction of an inch, more or less, on the external angle of the ilium; and that high or low withers are merely slight variations in the length of the superior spinus processes of the dorsal vertebræ; and that conformation depends upon the bony skeleton and muscular developments.

Much time with considerable actual practice should be

given to the study of unsoundness; to common forms of lameness, and the types of conformation which tend toward these unfortunate conditions. Common irregularities of the teeth are not discussed in these pages at all, and yet the general subject is an important and practical one, and one that is easily illustrated in classroom. These are given merely as suggestions and to impress the fact that this text is not expected to cover the entire field of veterinary teaching for all agricultural colleges.

I respectfully suggest that teachers should insist upon careful study of illustrations. In my own class work I find the constant difficulty that students glance at the illustrations carelessly and hurriedly, and thus fail to get the benefit which they might easily have from good illustrations. Students may be selected at random and asked to draw upon the board, from memory, illustrations from the lesson for that day. After a few practice lessons of this kind, students easily learn how to study textbook illustrations.

M. H. REYNOLDS.

University of Minnesota,
October, 1903.

PREFACE TO SECOND EDITION

I wish to express my appreciation of the very kind reception which has been given to Veterinary Studies by my fellow teachers in agricultural colleges, by agricultural papers, and by stockmen.

There have been no material alterations in this edition, but I am planning to embody criticisms and suggestions in revising for the third édition.

M. H. REYNOLDS.

University of Minnesota,
January, 1904.

PREFACE TO SEVENTH EDITION

I WISH to thank the many fellow teachers who have shown appreciation by continuing to use this textbook in spite of very evident need of revision. I wish to emphasize again the fact that Veterinary Studies is intended to quite an extent as a teacher's outline. It is not intended to give full instruction. Each teacher must add material as he may think wise, or leave out entire subjects according to local needs and his pupils. I find that very many pupils taking veterinary class work in agricultural schools need badly review work on physiology. The necessity for a practical working knowledge of physiology is self-evident. Some knowledge of anatomy is plainly necessary in order that disease processes may be located, and that students may understand animal conformation. Some elementary pathology is absolutely necessary in order that pupils may have some understanding of what disease processes really are.

Causes and prevention. Causes and prevention of diseases should be considered as of paramount importance, and only a comparatively few carefully selected diseases should be presented. These should be diseases which are uniform in symptoms and history and therefore easily recognized, and of such diseases only those that are rather easily and simply treated or are preventable.

There may be perhaps an exception to this, and that is for students living where stock owners do not have access to trained veterinarians. In such case it is a matter of plain common sense that they must simply do the best they can for themselves.

Credit is due Dr. H. T. Kinsley for assistance in revising "copy" for the chapters on pathology.

M. H. REYNOLDS.

UNIVERSITY OF MINNESOTA,
August, 1910.

CONTENTS

ANATOMY

ILLUSTRATIONS

VETERINARY STUDIES

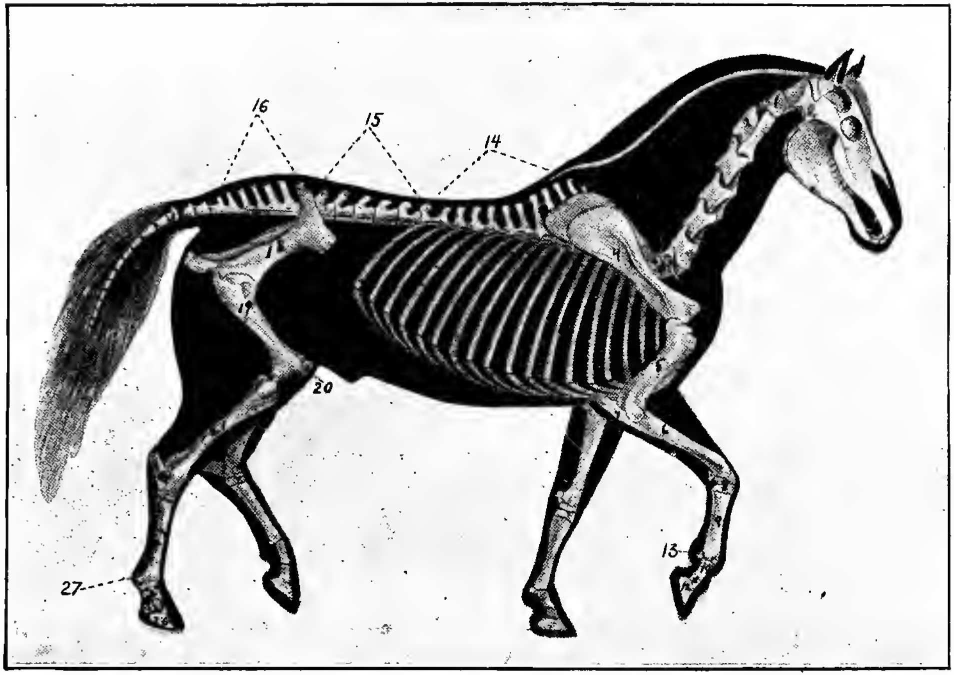

Fig. 1.—Skeleton. (*B. A. I.*)

1, Atlas; 2, axis; 3, seventh cervical vertebra; 4, scapula; 5, humerus; 6, radius; 7, ulna; 8, carpals; 9, metacarpals; 10, first phalanx; 11, second phalanx; 12, third phalanx; 13, sesamoids; 14, dorsal vertebræ; 15, lumbar vertebræ; 16, sacral vertebræ; 17, coccygeal vertebræ; 18, pelvis; 19, femur; 20, patella; 21, tibia; 22, tarsals; 23, metatarsals; 24, first phalanx; 25, second phalanx; 26, third phalanx; 27, sesamoids.

VETERINARY STUDIES

LECTURE I

ANATOMY

Definition.—Anatomy is the science which treats of forms, structures, and relations of body organs. These organs are divided for study into groups as follows: bones, muscles, joints, nervous system, circulatory apparatus, respiratory apparatus, urinary apparatus, and digestive apparatus.

OSTEOLOGY, BONES

Kinds. — Bones are classified as long, short, flat, and irregular.

Long bones, more or less elongated in form, medullary canal in shaft, found in limbs; example — humerus, femur, radius, and tibia.

The short bones are usually short in form, as the name implies. They have no medullary canal; example—carpals and tarsals.

Flat bones are those like the bones of the skull and the ribs, which consist of two plates of hard bony tissue connected by spongy bone.

Irregular bones are usually found in the median line of the body; example — vertebræ.

Peculiarities. — Those used in describing and recognizing bones are: elevations, depressions, borders, surfaces, angles, and extremities.

Development. — Bones develop either in cartilage or membrane. The long leg bones develop from cartilage; the flat skull bones develop from membrane.

FIG. 2.—HORSE'S SKULL.

1, Premaxillary bone; 2, upper incisors; 3, upper canine teeth; 4, superior maxillary bone; 7, nasal bones; 8, lachrymal bone; 11, malar bone; 12, upper molar teeth; 13, frontal bone; 15, temporal bone; 16, parietal bone; 17, occipital; 20, styloid processes; 24, parietal crest; 25, inferior maxilla; 26, inferior molars; 28, inferior canine teeth; 29, inferior incisor teeth.

Composition. — Normal bone of mature animals contains about one third animal matter and two thirds mineral matter. Animal matter gives elasticity; the mineral matter gives firmness and strength.

Groups. — Bones are divided into the following groups for study: Head, spinal column, sternum, ribs, front limb, hind limb.

Head consists of 26 bones, as follows: cranium 9, hyoid 1, face 16.

Cranium 9: occipital 1, frontal 2, parietal 2, temporal 2, ethmoid 1, sphenoid 1.

Hyoid 1.

Face 16: superior maxillary 2, inferior maxillary 1, premaxillary 2, palate 2, malar 2, lachrymal 2, nasal 2, vomer 1, inferior turbinated 2.

Teeth.— Mares have on each jaw: 6 incisors and 12 molars, or in all 18. Geldings and stallions have, in addition, 2

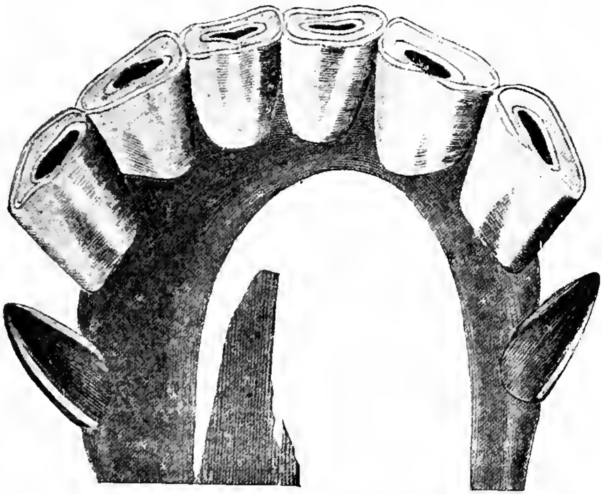

FIG. 3.—SIX YEARS, LOWER JAW.

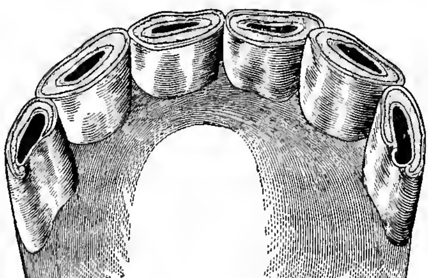

FIG. 4.—EIGHT YEARS, UPPER JAW.

Note.—Figures 4 and 5 are drawn on different scales.

canines or tushes, making 20 teeth on each jaw. All the incisors and the first three molars are temporary and are replaced. The last three come in as permanent teeth, according to the following table.

Cattle have 8 incisors on the lower jaw and none on the upper. Their molars are like those of horses in number, and the first three are also temporary.

DENTITION OF HORSES (Chauveau)

KIND	NUMBER	WHEN APPEAR	WHEN REPLACED
Incisors	Center . .	Birth	$2\frac{1}{2}$ years.
	Middle . .	4 to 6 weeks. .	$3\frac{1}{2}$ years.
	Corner . .	6 to 9 months .	$4\frac{1}{2}$ years.
Canines	. . . .	4 to 5 years . .	
Molars	1st	Birth	$2\frac{1}{2}$ years.
	2d	Birth	$2\frac{1}{2}$ years.
	3d	Birth	$3\frac{1}{2}$ years.
	4th. . . .	10 to 12 months	
	5th. . . .	2 years . . .	
	6th. . . .	4 to 5 years . .	

Age of horses by the teeth. — Tell by shedding and appearance of the teeth up to 4 years, according to table. Cups wear out of center pair of incisors of *lower jaw* at about 6 years; cups wear out of middle pair of incisors at about 7 years; and cups wear out of corner incisors at about 8;

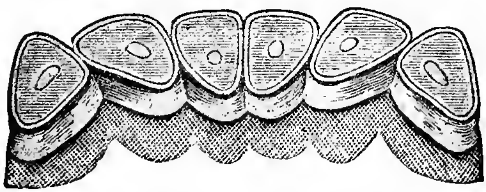

FIG. 5. — TWENTY YEARS, LOWER JAW.

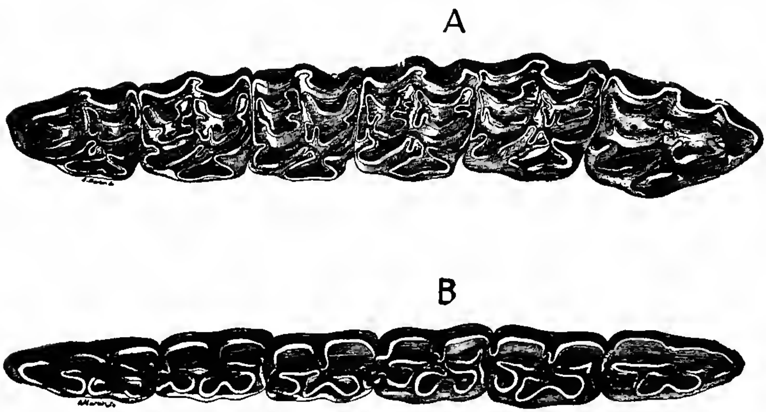

FIG. 6. — GRINDING SURFACES OF MOLARS.

Horse six to seven years old. A, right-hand superior molars; B, left-hand inferior molars.

cups wear out of center incisors of *upper jaw* at 9, middle pair at 11, and corner incisors at about 12. Quality of the teeth, kind of food, and the way the teeth fit together to be considered. They may wear very unevenly and be very deceptive. The upper incisors are much less reliable as to disappearance of cups than are the lower.

Original application. — The student should now make original observations, recording freely by notes and drawings. He should study the part played by individual bones or groups of bones in determining the size and shape of the head.

Study, *e.g.*, the nasal, frontal, superior maxillary, and inferior maxillary bones. Note what relation they bear to shape of nose, width between the eyes, "coarseness" of the head, and width between bones of the lower jaw.

Spend as much time as possible in practice at estimating horses' ages by their teeth. Note especially temporary and permanent teeth present, "cups," shape of wearing surface, etc.

LECTURE II

OSTEOLOGY

Spinal column. — This consists of about 52 pieces, called vertebræ. There are 7 cervical, 18 dorsal, 6 lumbar, 5 sacral, 15 to 18 coccygeal.

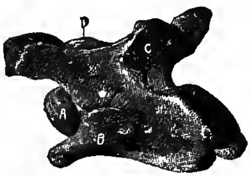

FIG. 7. — TYPICAL CERVICAL VERTEBRA.

A, Head of the body; B, transverse process; C, articular process; D, superior spinous process.

There are certain general characteristics possessed by all vertebræ, regardless of location in the spinal column; for instance, each vertebra has a body, arch, and spinal canal.

The *body*, convex in front and concave behind, is below the spinal canal. The head of the body of each vertebra is rounded and fits perfectly into the cavity of the rear end of the preceding vertebra. Between each pair is considerable cartilage, which serves the purpose of an elastic pad.

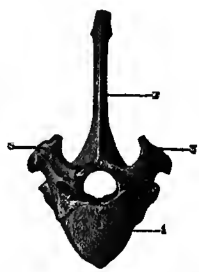

FIG. 8. — TYPICAL DORSAL VERTEBRA, FRONT VIEW.

1, Head of the body; 2, superior spinous process; 3, transverse process.

The *arch* incloses the sides and top of the spinal canal. (1) The *transverse processes* are the portions which project horizontally on each side from the arch. (2) The *superior process* projects upward from the top of the arch. (3) The *articular processes* are four in number: two in front, and two behind. The former articulate with the rear articular processes of the preceding vertebra, and the latter with the front processes of the succeeding. These make up the bony framework of the neck.

Cervical vertebræ. — There are 7 cervical vertebræ, all agreeing in certain general characters. The body is long, thick, and has an inferior spine projecting downward from its under surface. The superior processes are long from before to behind, and together form a long rough line. The transverse processes are also long from before to behind. In these characteristics the cervical vertebræ differ radically from the others.

Special cervical vertebræ. — There are certain cervical vertebræ which have marked individual peculiarities. The *atlas*, immediately supporting the head, has a small thin body with no head, but instead, two surfaces for articulating with the occipital bone. The *axis* is long, and has, in place of the head, a peculiar projection known as "odontoid process." This process is shaped somewhat like a tooth. Hence the name. The superior process is long from front to rear. The *seventh* cervical vertebra has a long superior process, somewhat resembling those of dorsal vertebræ. It also presents a small articular surface for articulation with the head of the first rib.

Dorsal vertebræ. — These are located in the back, and are 18 in number. They also have certain general characteristics. The body is short. There are four articular cavities, two in front and two behind for the heads of the ribs. Superior processes are long and flat from side to side, transverse processes short and small. None of the dorsal vertebræ differ very markedly from this general type.

Lumbar vertebræ. — These make up the framework of the loin. In general the body is longer and wider than the dorsal. The superior processes are also shorter. The transverse processes are also long, flat, and thin.

FIG. 9. — TYPICAL LUMBAR VERTEBRA, FRONT VIEW.

1, Body; 2, head; 3, superior spinous process; 4, transverse process.

Sacrum. — This constitutes the croup. It consists of five pieces, united in the adult. It articulates with the last lumbar vertebra in front, with

the first coccygeal vertebra behind, and with the pelvis on each side. This portion of the spinal column is triangular, with the base forward.

FIG. 10.—LATERAL VIEW OF THE SACRUM.
1, Spinal canal, anterior portion; 3, superior spinous processes.

Coccygeal vertebræ. — These are 15 to 18 in number, and located in the tail. The spinal canal is developed in the first three or four. The first one is occasionally united to the sacrum.

The sternum. — This is located in the front and lower portion of the chest, and extends from before to behind. It consists of six or seven pieces of cartilaginous bone and has distinct prolongations of cartilage from both the front and rear ends. On each side are articular surfaces for the first eight ribs. The sternum is commonly called the breast bone.

Ribs. — These usually number 18 pairs, and are described as the first, second, third, etc., beginning with the front pair. They all articulate above with the dorsal vertebræ; the lower ends of the first eight articulate with the sternum by means of cartilages. The remaining ten connect with the sternum by means of long cartilages, each of which rests against the preceding one. The ninth, or first asternal, rib is united rather closely to the eighth, which articulates with the sternum.

The *shaft* shows external convex and internal concave surfaces and two borders: anterior or front, and posterior or rear. The *superior* or upper *extremity* shows a head and a small projection, the tuberosity. These articulate with the dorsal vertebræ as already explained. Function of the ribs is to form a supporting and movable wall for the chest, protecting the soft organs and performing a very important function in opening the chest for respiration.

Practical application. — The student should now study, for himself, the part played by each group of vertebræ in determining the conformation of its region. Take, *e.g.* the cervical, dorsal, lumbar, and sacral groups and note what

relation they bear to length of neck, height and shape of withers and length of back, width and length of loin, length and slope of the croup. The student should also study the influence of shape of rib upon width of back and shape of sides. Record fully by notes and drawings.

LECTURE III

FRONT LIMB

This limb is composed of 20 bones, and includes the shoulder, arm, forearm, and foot.

The shoulder contains but one bone, the *scapula,* or shoulder blade. It is triangular and situated at the front and lower portion of the chest wall. Its direction is downward and forward, and it articulates below with the head of the humerus, or arm bone. The inner surface is somewhat concave. The external surface is divided into two portions by a long ridge which extends lengthwise of the bone. The upper portion is flat and thin.

The arm contains a single bone, the humerus. The *humerus* is a long bone. Its upper end articulates with the scapula, and the lower end with the ulna and radius. It offers for description a shaft, and upper and lower extremities. A peculiar feature of the shaft is a sort of furrow, which twists around the bone and is known in anatomy as the furrow of torsion. The superior extremity shows a rounded head which is fitted for articulation with a corresponding cavity of the scapula.

The forearm contains the *radius* and *ulna,* which in the horse and cow are firmly united. The radius belongs to the group classified as long bones, and articulates with the humerus above and the carpal bones below. The anterior surface of this bone is convex and smooth; the posterior surface, concave. The ulna is also a long bone, located just back of the radius. The shaft is triangular. The upper extremity shows a marked enlargement which is useful for attachment of muscles and gives leverage. It also contains

a deep notch for articulation with the humerus. The inferior portion of this bone is slender and more or less pointed, containing at its extremity a small knob.

The foot includes 7 carpals, 3 metacarpals, 2 sesamoids, 3 phalanges, and 1 navicular.

The *carpals* consist of seven small, short bones, and with the articulation of the carpals to the radius above, and the metacarpals below, make up what is commonly known as the knee joint.

The *metacarpals* are located in what is known as the region of the cannon. They are three in number: a large one in the middle, which is long and more or less cylindrical; and one rudimentary metacarpal on each side. These together articulate above with the carpals, and the large one below with the first phalanx and the sesamoids. The small metacarpals are commonly known as splint bones.

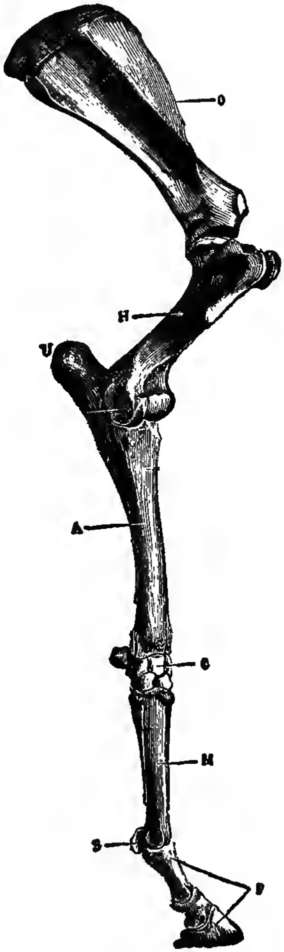

FIG. 11.—ANTERIOR LIMB OF THE HORSE.

O, Scapula; H, humerus; A, radius; U, ulna; C, carpals; M, metacarpals; S, sesamoids; P, phalanges.

The *first phalanx* is commonly known as the pastern. It is the shortest bone in the body that is classified as a long bone. The shaft shows an anterior convex surface and a posterior surface which is flattened and rough. The upper extremity is marked by two shallow cavities, separated by a median groove and fitted for articulation with the two convex surfaces and the median ridge which mark the inferior extremity of the large metacarpal. The

lower extremity has two articular surfaces separated by a median groove like that of the large metacarpal.

The *sesamoids* are two small, somewhat triangular, and irregular bones, placed side by side just back of the upper part of the pastern bone. These articulate with both the large metacarpal and first phalanx or pastern. They are side by side and together form a groove for the flexor tendons.

The *second phalanx*, or coronet bone, is short and somewhat square in form. It articulates with the first phalanx above, and the third phalanx and navicular below. The upper and lower extremities of this bone resemble the upper and lower extremities of the first phalanx.

The *third phalanx*, or pedal bone, is pyramidal in shape and irregular. Its superior face shows two shallow cavities separated by a median ridge fitted for articulation with the second phalanx. The anterior face is convex and quite rough. The inferior surface is the one on which the foot rests. It is called the sole. The superior border of the anterior face has quite a projection which is especially fitted for the insertion of a tendon. This is technically known as the pyramidal process. The lower portion of this bone is continued outward and backward on each side into what is known as the wing.

The *navicular bone* is located just back of the upper part of the third phalanx and is articulated to that bone. It is long and narrow, and placed transversely. Its anterior surface articulates with the third phalanx. Its posterior surface is covered with cartilage and forms a gliding surface for the tendon of the deep flexor muscle which passes over this bone to its attachment on the sole or inferior surface of the third phalanx.

LECTURE IV

POSTERIOR LIMB

THIS limb also contains 20 bones, and is divided for study into pelvis, thigh, leg, and foot.

The pelvis is divided into two halves, each half being composed of three bones closely united. These bones are distinct in early life, but become united as the animal grows older. The two halves of the pelvis bound the pelvic cavity, which contains the rectum, bladder, and sexual organs. Each half of the pelvis articulates with the sacrum.

The thigh contains one bone, the *femur*, which articulates above with the pelvis and below with the larger of the two leg bones. The femur belongs to the group which we have classified as long bones, and is the heaviest and strongest bone in the body. This bone offers for study a shaft, upper and lower extremities. The shaft shows three faces, — external, internal, and anterior, which are smooth and convex, and a posterior face which is rough and irregular on the surface. There is a large projection on the upper portion of the posterior face called the internal trochanter. On the upper extremity we find a smooth rounded head which articulates with a deep cavity in the pelvic bone above. On the external surface and projecting above the head is the external or great trochanter. The inferior extremity is somewhat flat from side to side and shows two rounded surfaces which we will call condyles. These are separated by a deep groove known as the trochlea.

The leg contains three bones, — tibia, fibula, and patella.

The *tibia* is a long bone with a somewhat triangular shaft, larger at the upper than at the lower end. It articulates

above with the femur, patella, and fibula, and below with the bones of the hock, *i.e.* the tarsal bones. This bone, like the femur, offers for study a distinct shaft, upper and lower extremities.

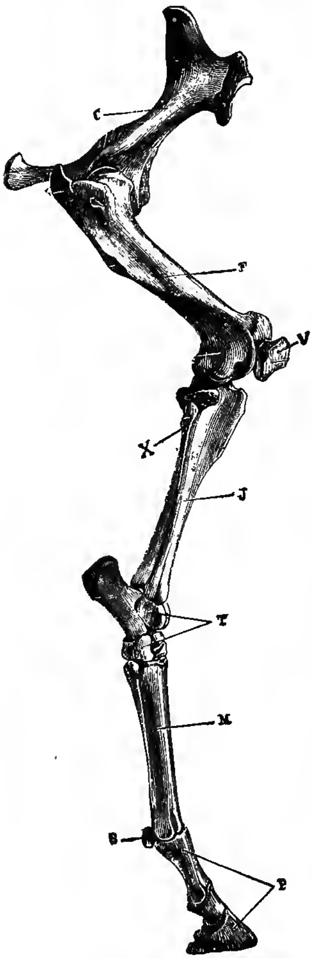

FIG. 12.—POSTERIOR LIMB OF THE HORSE.

C, Pelvic bone; F, femur; V, patella; J, tibia; X, fibula; T, tarsals; M, metatarsals; S, sesamoids; P, phalanges.

The *shaft* of the tibia presents three surfaces,—the external, internal, and posterior; and three borders, — the anterior, external, and internal. The *superior extremity* shows in front a depression for one of the ligaments which attaches the patella to the tibia, a small articular surface for the fibula on the outer side, two oval depressions with a marked projection between them for articulating with the condyles of the femur. These are smooth and covered with articular cartilage. The *inferior extremity* presents an external and an internal tuberosity. Its articular surface consists of two shallow cavities and a median ridge, all three of which extend diagonally forward and backward.

This bone articulates with four others; viz. femur, patella, fibula, and one of the tarsal bones.

The *fibula* is a small rudimentary bone which articulates with the external portion of the head of the tibia, and is situated on the external side of that bone.

The *patella* is small, short, and located in front of the lower extremity of the femur, and attached to the tibia

below by three strong ligaments. It is displaced outward when the limb is in the condition popularly known as "stifled." This bone offers for study three faces: superior, to which muscles are attached; the anterior, which is convex and somewhat irregular; and the posterior, which is so shaped as to fit nicely into the femoral groove already mentioned.

The foot bears a very close resemblance in its anatomy to the corresponding portion of the anterior limb, and is divided for study into the tarsus, metatarsus, and digit.

The *tarsus* is composed of six or seven small bones, arranged in two rows, the upper row containing the astragalus and os calcis. The lower row usually consists of four small bones. Two of these are especially interesting because they are the common seat of bone spavin.

The astragalus is interesting because it furnishes the articular surfaces for the lower end of the tibia.

The os calcis is somewhat elongated and lies behind the astragalus. It corresponds to the prominent portion of the human heel. The bones of this region correspond to the human tarsal bones making up the ankle.

The *metatarsus* consists of three bones, a large one in the center and one small rudimentary bone on each side, *i.e.* on the inside and outside of the middle bone. The large metacarpal furnishes the supporting axis for this region as in the anterior limb. The shaft is fairly smooth and has a small articular surface on each side for the rudimentary metatarsal. It is supposed that the small metacarpal and metatarsal bones are merely survivals in the process of evolution, and that in the earlier history of the various animals from which the modern horse is descended these bones were larger than they are now, having the same length and the same functional importance as the principal metacarpal and metatarsal bones. The original ancestor of the horse is supposed to have had five metacarpals and five metatarsals with corresponding digits or toes.

Each *digit* contains three bones known as the phalanges,

the horse having three phalanges and the cow six. These are commonly known as the first, second, and third phalanges, or os suffraginis, os corona, and os pedis. The anatomy of this region is discussed more fully in the special chapter on the foot.

The phalanges, sesamoids, and navicular bones are very similar to the corresponding bones of the front limb, already described.

Original observations. — The student should now make careful observations for himself and record freely by notes and drawings. He should study as before the part played by each bone or closely associated groups of bones in determining the size and shape of the part wherein it is placed. For the front limb study in this relation the scapula, ulna, and radius combined, metacarpals, and first and second phalanges. In the hind limb study in this way the pelvis, femur, tibia, os calcis, and metatarsals.

Animal husbandry students should find this application of the preceding lessons helpful by giving a clear view of the anatomical basis of conformation and type.

LECTURE V

ARTICULATIONS OR JOINTS

Articulations are divided into several groups for the purpose of study. These groups are: immovable, slightly movable, and freely movable.

Examples: Immovable, between the skull bones; slightly movable, between vertebræ; freely movable, between scapula and humerus.

Freely movable. — The freely movable articulations are subdivided according to shapes of the articular surfaces and varieties of movement that can be produced. These subdivisions are: ball-and-socket, hinge, pivot, imperfect hinge, and gliding.

The *ball-and-socket* articulation, of which we find examples at the shoulder and hip, is made by a rounded head of one bone fitted into a rounded cavity of some other bone; for instance, at the shoulder we have a rounded head of the humerus fitted into a glenoid cavity of the scapula. At the hip a rounded head on the superior extremity of the femur fits perfectly into the cotyloid cavity of the pelvic bone. It will be readily seen that the ball-and-socket joint permits the greatest variety of movements.

The *hinge joint* is made by two articular surfaces of such shape and so fitted together that no lateral or rotary motion is possible. Only two movements are allowed at joints of this kind: flexion and extension. The articulation between the humerus above and the ulna and radius below offers a good example of this kind.

Pivot joint is one where portions of two bones are in contact in such a way as to permit of rotary motion; for example, between the atlas and axis, the rotation being

around the odontoid or toothlike processes of the axis. Articulations of this kind permit of rotation only.

The *imperfect hinge* joint is one which permits of two principal motions — flexion and extension, and to a limited extent some other motion, as for instance rotary or lateral movement. We may find a type of this articulation between the temporal and inferior maxillary bones, or between the femur and tibia. Articulations of this kind are formed by oval heads fitting in oval sockets.

Gliding joints permit only simple gliding movement between the articular surfaces. The articular surfaces in joints of this kind are more or less nearly flat.

Immovable. — At *immovable articulations* the bones are firmly united by cartilage and practically continuous with each other.

Slightly movable. — At *slightly movable articulations*, bones are united by a cartilage which is elastic enough to permit of slight movement, *e.g.* the common intervertebral articulations.

At *freely movable articulations* the articulating bony surfaces are each covered by a thin layer of smooth, glistening, and elastic articular cartilage. This cartilage gives a smooth gliding surface. It also lessens jar by its elasticity and protects the bony surface beneath.

Structures at joints are bones, ligaments, tendons, muscles, synovial membrane, and synovial fluid.

Ligaments are either bands or sheets of white or yellow connective tissue. The white ligaments are very strong and inelastic. Their sole function is to hold bones together at articulations. The yellow ligaments are composed of yellow elastic connective tissue, and are especially useful as assistants to muscles, particularly in supporting parts of the body, like the head of the horse, which constantly tend to fall.

Synovial membranes are sometimes called capsules. These are serous membranes, quite thin, but composed of two layers, deep and superficial. This membrane affords at

each joint a closed sack and is for the purpose of secreting synovia. Synovial membranes do not cover the surface of the articular cartilage, as is frequently supposed, but usually inclose the articulations like sacks, being attached at one side near the edge of the articular surface of one bone, and at the other side near the articular edge of the other bone. The membranes are usually also attached to the inner surface of the capsular or other ligaments of the joint.

Synovia is a viscid fluid, slightly yellow or nearly colorless. It has an oily feeling, but is not an oil chemically. This fluid is quite rich in albumen, which gives it the viscid property, and adapts it so well for lubricating articular surfaces. Muscles and tendons are discussed in Lecture VI.

Kinds of motion are: *flexion*, or bending, in which the two articulating bones are brought nearer each other; *extension*, the reverse of flexion, by which bones are straightened on each other; *adduction*, bringing the lower extremity of the moving bone toward the median line; *abduction*, in which the lower end of the moving bone is carried from the median line; *circumduction*, in which the articulation forms the apex of a cone circumscribed by the moving bone; *rotation*, in which one bone rotates as a pivot on another.

Joints are named according to the bones involved. In the limbs the upper bone is named first. In the vertebræ, the anterior bone is named first.

DESCRIBING ARTICULATIONS

Scapulo-humeral. — This is a ball-and-socket joint, the rounded head of the humerus fitting the glenoid cavity of the scapula.

Ligaments at this joint are: (*a*) glenoid, a cartilaginous rim around the cavity which deepens the cavity; (*b*) capsular, a sort of capsule fitting around the joint like a bag; (*c*) two bundles of ligament fibers in front of the joint connecting the extremities of the scapula and humerus.

Movements. — All the motions, except true gliding, are

possible at this articulation. The synovial membrane is quite loose and affords a lining for the capsular ligament.

First interphalangeal articulation. — This is an imperfect hinge joint. The articular surface of the inferior extremity of the first phalanx is characterized by two condyles and a median groove which fit with two shallow cavities and a median ridge on the superior extremity of the second phalanx.

Ligaments. — The articular extremities which make up this articulation are supported by the following ligaments and tendons: in front by the tendon of the anterior extensor muscle; on the sides by two lateral ligaments, one on each side; behind by the posterior ligament and the tendons of the shallow and deep flexor muscles which pass over the posterior of the joint. The posterior ligament is really a thick strong pad of fibrocartilage.

Movements. — Flexion and extension, together with a limited lateral movement.

LECTURE VI

MUSCULAR SYSTEM

The peculiar property of muscle tissue is the power of self-contraction and self-movement. The muscles of the animal body are divided into voluntary and involuntary.

Voluntary muscles are under the control of the will through the cerebrospinal system.

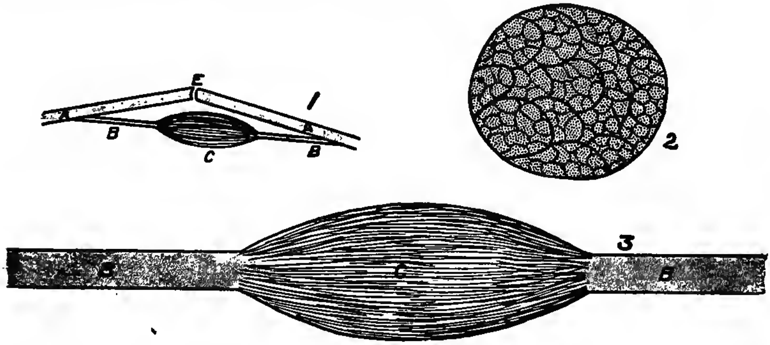

Fig. 13.—Voluntary Muscle. (*M. H. R.*)

1. Action of Muscle in Producing Motion. Muscle does its work by shortening its belly. A, A, Bones; B, B, tendons; C, belly of muscle; E, articulation (joint).
2. Muscle in Cross Section. Showing "bundle of bundles" arrangement of the fibers. Dots represent single fibers.
3. Diagram of Simple Muscle. B, B, Tendons; C, belly (lean meat).

Involuntary muscles act independently of the will, and are under the control of the sympathetic nervous system.

Voluntary muscles. — What is popularly termed "lean meat" is composed of voluntary muscles. These are classified into simple, digastric, biceps, triceps, penniform, bipenniform.

A *simple* muscle is characterized by a single belly with not more than one tendon at either end; a *digastric* muscle has

two bellies connected by a tendon; a *biceps* muscle has two tendons at one end; a *triceps* muscle has three tendons at one end; *penniform*, when the fibers attach to one side of a tendon; *bipenniform*, or featherform, is characterized by fibers attaching to two sides of a continuous tendon.

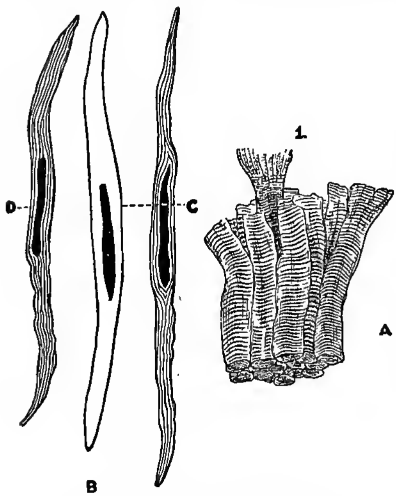

FIG. 14.—MUSCLE FIBERS.

A, Bundle of voluntary fibers, side view. B, C, D, Three involuntary fibers, spindle-shaped cells with nuclei.

They are also classified according to function into flexors, extensors, abductors, adductors, and rotators.

The *belly* is the active working part (lean meat). The *tendon* merely serves to give connection with a distant object, usually a bone. Tendons are strong, but have no power of contraction. The strength of a muscle depends upon the thickness of the belly. The extent of its movement depends upon the length of the belly.

The two ends of a muscle are defined as origin and insertion. The *origin* is the less movable end; *insertion* the more movable end. It may happen at one time that one end is the insertion, at another time the origin.

A muscle produces motion by pulling upon some bone which acts as a lever with the fulcrum at a joint.

The muscle fibers may attach directly to the bone, or indirectly through tendon fibers. The connection between the muscle fiber and the tendon fiber is by insertion of the conical point of the muscle fiber into a conical cavity at the end of the tendon fiber.

Structure. — The voluntary muscle consists of bundles of bundled fibers; each individual fiber has its own delicate

sheath. A number of fibers are inclosed within a common connective tissue sheath and constitute a minute bundle. A number of these bundles are in turn wrapped within a connective tissue sheath, forming a larger bundle. These larger bundles may in turn be wrapped by means of another connective tissue sheath into a still larger bundle.

The voluntary muscle fiber is long, threadlike, marked by cross stripes which are very close together, and may end in tendon fiber. These muscle fibers are about $\frac{1}{1500}$ of an inch wide, but may be very long.

Involuntary muscles. — Involuntary muscle fibers are merely long, spindle-shaped cells, which do not end in tendon fibers. They may be arranged in the form of small bundles, and are usually in the form of thin sheets. Involuntary muscle tissue is lighter in color than voluntary, and usually incloses hollow organs forming one of the coats or layers. The middle coat of the stomach and intestines is composed of involuntary muscle fibers.

Function. — It is their function to carry on work which could not be intrusted to conscious control and with which the brain could not well be burdened.

Peristaltic action of the stomach and intestines is produced by the rhythmic action of these muscle fibers. The heart muscle fibers differ from both the typical voluntary and the typical involuntary fibers. They are striped, but operate independently of the will.

Source of heat and power. — Muscular power comes from oxidation of food material in the various tissues of the body, particularly in the muscles and larger glands. During the process of oxidation, carbonic gas and other materials are developed. Power is increased by proper nourishment, and is decreased by lack of nourishment. Muscles lose in strength by overwork because they are consumed more rapidly than rebuilt. Muscles are paired in a double sense. The rule is that for any given muscle there is a corresponding muscle on the other side of the body, and also one or more opposing muscles on its own side.

The belly of a muscle has a rich blood supply; the tendon has very little.

Description of voluntary muscle. — The masseter muscle is located on the outer part of the cheek. *Form*, flat, broad, thick, four-sided. *Origin*, on the temporal and superior maxillary bones. *Insertion*, on the outer surface of the inferior maxillary. *Action*, elevates the lower jaw. *Nerve supply*, from a branch of the fifth cranial nerve (trifacial).

Application. — The student should now make practical observations for himself, recording as in previous lectures. He may select at the teacher's discretion several short thick muscles and several long slender ones, and should note locations, attachments, and probable functions, and should make a statement concerning the probable working efficiency of muscles of these different types. This refers to the amount of load to be moved and long or short distance of movement. This work may be done from charts, papier-maché models, or better, from actual dissection.

Study a skeleton, and also a horse in motion, and note how the horse pulls, or lifts a load. What occurs at the articulations and how is this brought about?

Study the location and size of muscles and the relations of these considerations to body conformation.

LECTURE VII

NERVOUS SYSTEM

Function. — The peculiar function of the nervous system is to control the various organs and systems of the body, and compel them to work in harmony. The peculiar property of nerve tissue is irritability. The nervous system is composed of nerve centers, nerve trunks, nerve fibers, and nerve cells.

A *nerve center* is composed of ganglion cells, nerve fibers, connective tissue, and blood vessels. The function of a

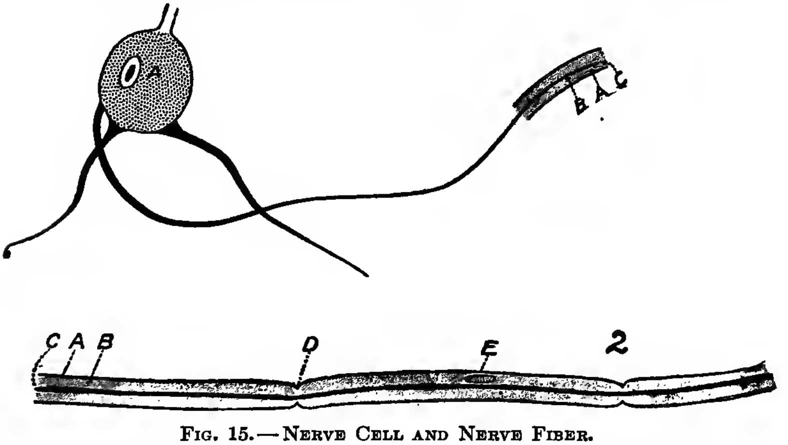

FIG. 15.—NERVE CELL AND NERVE FIBER.

A, Nerve Cell with Several Poles. One pole continues as a medullated nerve fiber. A, Primitive sheath; B, medullary sheath; C, axis cylinder.

2. Medullated Nerve Fiber. A, Primitive sheath; B, medullary sheath; C, axis cylinder; D, node; E, nerve corpuscle.

nerve center is to receive and dispose of impressions which may be brought to it, to connect nerve fibers, and in the case of the forebrain to originate conscious impulses.

A *nerve fiber* is composed in some cases of a central fiber

surrounded by one or two protecting sheaths; in other cases, of the central fiber only. Nerve fibers conduct impulses between the various tissues and organs and the nerve centers.

A *nerve trunk* is composed of an indefinite number of nerve fibers supported within a common sheath.

A *nerve cell* is an irregularly shaped microscopic cell, having a varying number of branches, one of which, in case of the motor cells, may continue to indefinite length as the axis cylinder or central fiber previously mentioned.

Nerve fibers are classified according to function into: motor, sensory, and special sense.

Motor fibers are those which convey impulses to the muscles and control muscular action.

Sensory fibers are those which convey impulses toward brain centers and supply only sensation to the structures to which they are distributed.

Fibers of *special sense*, as in olfactory, optic, and auditory nerves, transmit only sensations that pertain to the functions of the special senses, like hearing and sight.

Many of the cranial and facial nerves contain both motor and sensory fibers and are therefore mixed.

Nerve trunks are therefore classified as motor, sensory, mixed, and nerves of special sense, according to the kind or kinds of fibers composing them.

The nervous system is subdivided for study into the cerebrospinal and sympathetic nervous systems.

CEREBROSPINAL SYSTEM

The cerebrospinal nervous system consists of the brain and spinal cord together, with their nerves and ganglia. The brain and spinal cord should be considered as one complex organ located within a continuous canal, the brain to be considered as merely an enlargement at the anterior extremity. The cranial cavity should be considered as an enlargement at the anterior extremity of the spinal canal.

The cranial bones may be considered as peculiarly developed vertebræ.

The **brain** is located in an ovoid cavity, the walls of which are formed by the cranial bones. It is covered by three membranes: (1) The *dura mater* is tough, thick, and strong, and exactly fitted to the inner surface of the cranial bones.

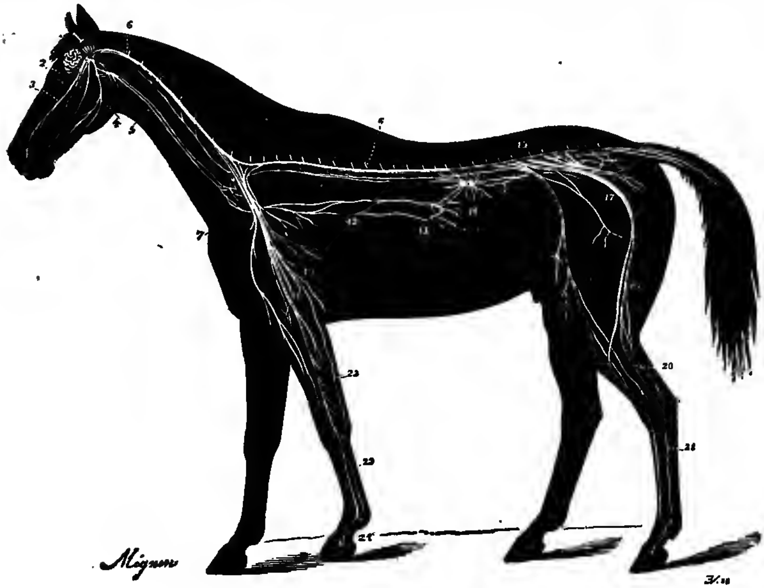

FIG. 16. — CEREBRO-SPINAL NERVOUS SYSTEM.

1, Brain; 2, optic nerve; 3, superior maxillary nerve; 4, inferior maxillary nerve; 5, pneumogastric nerve; 6, spinal cord; 10, radial nerve; 11, median nerve; 12, pneumogastric nerve; 13, portion of solar plexus; 14, solar plexus; 17, sciatic trunk; 19, great sciatic nerve; 20, posterior tibial nerve; 21, posterior plantar nerve; 22, internal radial nerve; 23, anterior plantar nerve; 24, digital nerves.

(2) The *arachnoid* consists of two layers forming a closed sack, the outer layer fitted closely to the dura mater, and the inner layer fitted closely to the pia mater. (3) The *pia mater* is thin, delicate, and fits closely to the brain substance — over the convolutions and into the depressions.

Gray matter, folded into convolutions, covers the surface. The interior is composed of white matter.

Function. — The physiological function of the brain is to

receive messages, consider information, and send out appropriate impulses or orders to the proper organs.

Divisions. — The brain is divided for study into: (*a*) cerebrum; (*b*) cerebellum; (*c*) medulla; (*d*) isthmus.

The *cerebrum* is largest, and located in the anterior part of the brain cavity, and is divided into two lobes or hemispheres by the median fissure.

The *cerebellum*, smaller than the cerebrum, is located in the posterior and inferior part of the brain cavity, and consists of three small lobes. Section shows the arbor-vitæ (tree of life) arrangement of nerve tissue. It is the function of the cerebellum to control the voluntary muscles that they may work in harmony.

The *medulla* is a continuation of the spinal cord and extends from the occipital opening in the brain cavity to the pons or bridge, and is located posterior and inferior to the cerebellum.

Within the medulla are located a number of important centers, among them, the ones controlling respiration; the caliber of blood vessels, distribution of the blood according to the needs of the body; the center controlling the processes of swallowing; the vomiting center; and the center controlling the secretion of saliva.

The *isthmus* is that part of the inferior portion of the brain which connects the pons with the cerebrum.

Cranial nerves. — There are twelve pairs, of which the 1st is *olfactory* (nerve of smell); 2d, *optic* (sight); 3d, *occulomotor,* to muscles of the eyeball; 5th, *trifacial,* to eye, skin of the face, teeth, etc.; 7th, *facial,* to muscles of face; 8th, *auditory,* to internal ear — hearing; 9th, *glossopharyngeal* to tongue and pharynx, sense of taste and general sensation; 10th, *pneumogastric,* sometimes called the wandering pair, distributed to heart, lungs, stomach, liver, intestines and other abdominal organs.

Spinal cord is that portion of the cerebrospinal system which extends within the spinal canal from the occipital opening to the sacrum. It weighs about 10.5 ounces and con-

sists of white matter on the outside and gray matter in the interior, and is covered by the same three membranes as the brain. The spinal cord is marked throughout its entire length by two fissures, one extending along the superior surface, and another along the inferior surface.

It is the function of the spinal cord to act as a means of communication between the brain and spinal nerves, and as a reflex nerve center.

Spinal nerves. — There are about 42 pairs. Each nerve has *origin* in two roots. One root (superior) comes from the upper portion of the cord and is composed of sensory fibers. The other root (inferior) comes from the lower portion of the

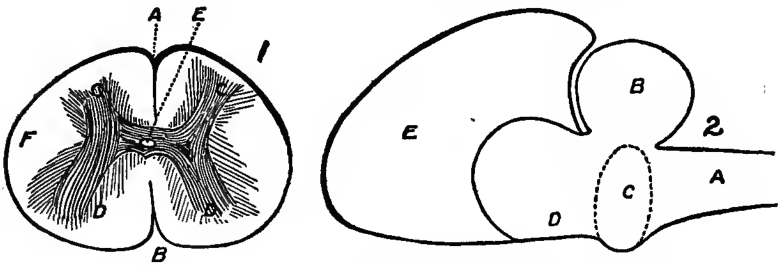

FIG. 17.—SPINAL CORD AND BRAIN IN DIAGRAM. (*M. H. R.*)

1. Cross Section of the Spinal Cord. A, Superior median fissure; B, inferior median fissure; C, C, superior gray horns; D, D, inferior gray horns; E, central canal; F, white substance.
2. Vertical Mid-Section of Brain. A, Medulla; B, cerebellum; C, pons or bridge; D, isthmus; E, cerebrum.

cord and is composed of motor fibers. The nerve is therefore mixed.

These nerves *emerge* from the spinal canal in pairs, one on each side and at each articulation of the vertebræ. They are *named* cervical, dorsal, etc., according to location in the spinal column.

The spinal nerves *supply*, by their superior branches, the skin and muscles of the neck and spinal column. By their inferior branches they supply the lower portion of the body and limbs and furnish other branches which in part make up the two great sympathetic nerve trunks.

THE SYMPATHETIC SYSTEM

This consists of two cords, one on each side of the spinal column, and extending from the head to root of tail, together with all the nerves which branch from these two trunks. These cords are not smooth, but have enlargements called ganglia at intervals along their course. Each cord resembles somewhat a small, rather flat, and knotted rope.

Composition. — These two trunks are composed of nerves from the medulla and from the inferior branches of all the spinal nerves except the coccygeal. By this arrangement of composition and the frequent connections of sympathetic with cerebrospinal nerves, there is constituted a very perfect union of these two systems into one great nervous machine.

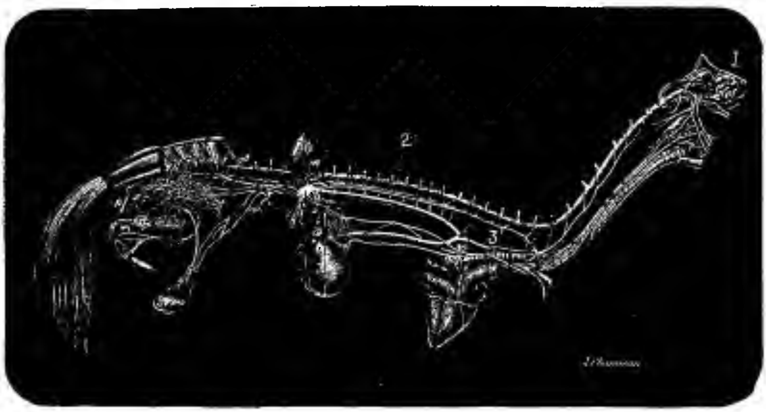

Fig. 18. — Relation of the Sympathetic and Cerebrospinal Systems. Partly Diagrammatic.

1, Brain ; 2, spinal cord ; 3, sympathetics.

Ganglia. — The knots along the two main trunks are ganglia of nerve cells and fibers. One of these, the solar plexus, is really composed of two large ganglia, united by a large cord and many filaments. It supplies the stomach, intestines, liver, pancreas, spleen, and kidneys. An injury to the solar plexus is always serious.

Sympathetic nerves. — These control in part involuntary muscle fibers and through these the organs of circulation, respiration, and digestion, and in part the work of the various glands including the liver, spleen, pancreas, and kidneys. Sympathetic nerves are gray; cerebrospinal nerves are white.

Practical application. — The student should now make practical observations, recording fully. He may, for example, record past experience or present observations concerning horses and cattle, taking those of sluggish, well-balanced, and highly nervous organizations. Compare these different types as to working efficiency, feeding, and keeping quality. Note the effect of excitement on high-type dairy cows as to production — quantity and quality of milk considered.

In making these studies, he should bear in mind that the quantity and quality of digestive fluids, food absorption, distribution and utilization of food material, the amount of blood flowing through a cow's udder, and the degree of gland cell activity in the udder are all under the direct influence of the nervous system.

LECTURE VIII

CIRCULATION

Blood is a complex fluid consisting of serum, fibrin factors, and two kinds of corpuscles, — the red and the white. Its temperature differs in the various domestic animals from 101° to 104° F., — the horse 100° to 101.5° F. and the cow about one degree higher; sheep vary from 100° to 104°. Its specific gravity is about 1050, and it constitutes about one tenth the body weight.

Circulatory apparatus — heart, arteries, veins, capillaries, lymphatic vessels, and lymph glands.

The *heart* is located within the pericardium, which supports the heart in place beneath the 3d, 4th, and 5th dorsal vertebræ by attaching to the large blood vessels at its base; to the diaphragm behind, and to the sternum below. It measures about 10.5 inches in length by 7.5 wide at the base, is cone-shaped, and weighs 6.75 pounds. The heart contains four cavities, easily seen by cutting the heart open. Two located at the base are called auricles; and two at the apex, ventricles.

The auricles are much alike, as are also the ventricles, except that the left ventricle is larger and has a wall which is more than twice as thick as the right. The heart is covered by the pericardium and lined with the endocardium. Its muscle fibers are involuntary so far as control is concerned, but are striped.

Course of the blood.—Beginning with the blood entering the right auricle through the anterior and posterior venæ cavæ and coronary veins, it then passes through the right auricle, thence into the right ventricle, thence to the lungs

through the pulmonary artery, back to the left auricle, through four pulmonary veins, past the valves on the left side, to the left ventricle, and is then sent by this ventricle through the systemic circuit. The systemic blood leaves the left ventricle through a large artery called the aorta.

The opening between the right auricle and the right ventricle is guarded by the right auriculo-ventricular valve; the opening between the right ventricle and the pulmonary artery is guarded by the right semilunar valve.

The opening between the left ventricle and the left auricle is guarded by the left auriculo-ventricular valve, and the opening to the aorta from the left ventricle is guarded by the left semilunar valve.

The *pulmonary circulation* is the flow of blood which occurs between the heart and lungs.

The *systemic circulation* is that which occurs between the heart and all the rest of the body, except the lungs.

Arteries, veins, and capillaries. — Arteries have thicker and more elastic walls; remain open after death, although empty; the stream flows in jets; the blood is lighter in color than that in the veins and flows from the heart. Arteries have no valves. In all these points the arteries differ from the veins. Both have three coats: outer, fibrous; middle, muscular; and inner, serous.

Capillaries are the small vessels and spaces which connect minute arteries with minute veins.

BLOOD SUPPLY OF THE BODY

Arteries. — The aorta is the trunk artery which receives blood from the left ventricle for the systematic circuit. It is about two inches long and branches into two large trunks; viz. the anterior aorta and the posterior aorta. The anterior supplies the head, neck, and front limbs; and the posterior supplies in a general way the rest of the body.

Anterior aorta is smaller and shorter (one inch long); course is upward and forward. It divides into the right

and left axillary arteries. These lie near the trachea, one on each side, for a short distance, and then bend around the anterior borders of the first ribs and terminate at the inner part of each shoulder in the humeral arteries, which are the continuing branches of the axillary. Each humeral furnishes blood for the corresponding front limb.

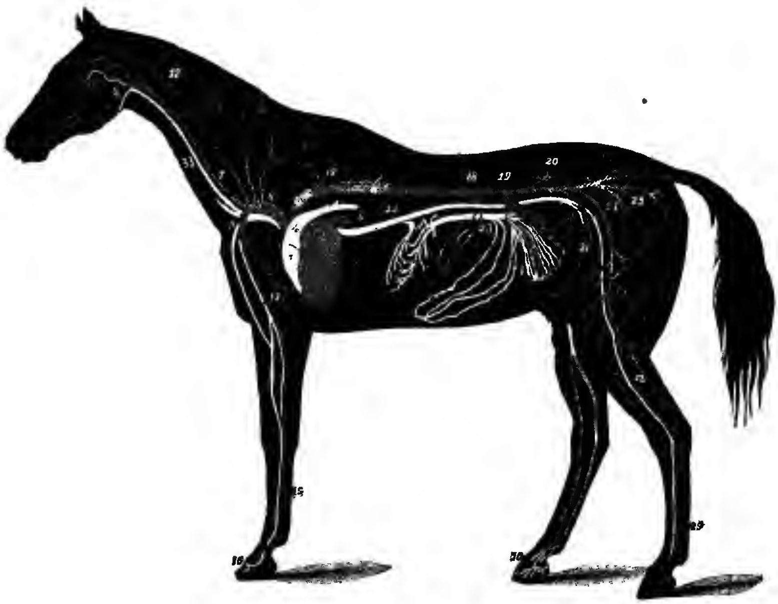

Fig. 19.—Circulation. Arteries Gray, Veins White.

1, Heart, right ventricle; 2, left ventricle; 3, left auricle; 4, pulmonary artery; 5, pulmonary veins; 6, anterior aorta; 7, carotid artery; 9, left axillary artery; 13, humeral artery; 14, radial artery; 15, metacarpal artery; 16, digital artery; 17, posterior aorta; 18, coeliac trunk; 19, mesenteric trunk; 20, renal (kidney) artery; 22, posterior vena cava (vein); 23, portal vein; 24, external iliac artery; internal iliac artery; 27, femoral artery; 28, posterior tibial artery; 29, metatarsal artery; 30, venous supply to the foot; 33, jugular vein.

The *common carotid* arteries, right and left, supply various structures in the neck and head. These have their origin in a single vessel, the cephalic artery, which branches from the right axillary near the division of the anterior aorta into right and left axillary arteries.

A corpuscle, on its way from the heart to the brain, would

pass through the aorta, anterior aorta, right axillary, cephalic, and common carotid, and then through a branch of the carotid to the brain.

Posterior aorta curves upward and backward, through the diaphragm, then under the bodies of the dorsal and lumbar vertebræ to the lumbo-sacral articulation. This large artery supplies blood to the thoracic and abdominal organs, and then terminates in four branches named iliacs, — two external and two internal.

The two external iliacs correspond somewhat to the two axillaries in front and the two femoral arteries to the two humeral, for it is the femoral arteries which continue the external iliacs and distribute blood to the posterior limbs and feet.

The two internal iliacs are smaller and distribute blood to the pelvic organs.

Veins. — These usually accompany arteries. One large vein commonly accompanies each large artery and two small veins accompany each of the smaller arteries; but this is not a fixed law.

The *anterior vena cava* corresponds to the anterior aorta and the *posterior vena cava* to the posterior aorta. Each returns the blood to the heart which its corresponding aorta has distributed.

All the veins except those of the bones, small veins in the feet, and the veins of the brain and spinal cord, have valves.

Valves are most common and numerous in the veins of the extremities and in those veins which pass through and among voluntary muscles.

Pulmonary veins, four in number, have their origin within the lungs. They return blood from lungs to heart in the pulmonary circuit and carry pure blood.

The *anterior vena cava* has its origin between the two first ribs at the juncture of the two jugular and two axillary veins. Jugular vein corresponds to carotid artery, and axillary vein to axillary artery.

The *posterior vena cava* has its origin near the last lumbar

vertebra by the union of the common iliac veins. It passes beneath and at one side of the bodies of the vertebræ, through liver and diaphragm, to the right auricle of the heart.

LYMPHATIC SYSTEM

Parts. — The *lymphatic system* consists of vessels and glands. The current in the vessels is like that in the veins in that it flows toward the heart and is very sluggish.

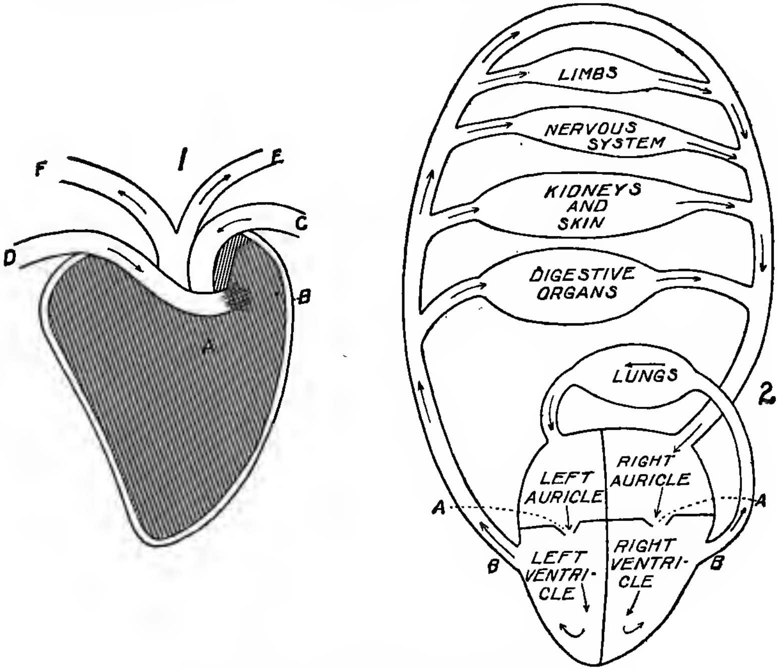

Fig. 20. — Circulation. Diagrammatic.

1. Heart and Blood Vessels. A, Heart; B, pericardium; C, anterior vena cava; D, posterior vena cava; E, anterior aorta; F, posterior aorta.

2. The Circulation in Diagram. A, A, Auricle-ventricle valves; B, B, semilunar valves.

Lymphatic vessels. — These have thin transparent walls and are found in most of the body tissues. They have valves like the veins and carry lymph, or, in the lacteals, chyle. The lacteals are lymphatic vessels which drain the digestive canal, chiefly the small intestines.

There are two main vessels: the thoracic and right lymphatic.

The *thoracic* is situated along the vertebral column within the abdomen and thorax, on the right side, near the heads of the ribs. It has its origin in one dilatation or receptacle and terminates in another before emptying into the anterior vena cava. Its opening in the vein is protected by a valve in order that blood may not get into the duct. This duct drains all the body except the right side of the face, right side of head and neck, right shoulder, and right front limb.

The *right lymphatic duct* is a very short vessel into which empty all the vessels which drain these latter regions.

Lymph glands. — The lymph glands serve in part to remove from the lymph disease germs and other harmful bodies. Their function is something like that of a filter.

Function. — The lymph fluid distributes nourishment by osmosis directly to the body tissues, and removes waste materials by the same process. The nutritious materials are as a rule taken into the lymph from the blood, and waste materials which the lymph receives from the tissues are poured into the blood through the thoracic duct and the right lymphatic duct.

LECTURE IX

RESPIRATION

Definition. — Respiration is the process by which the various tissues gain oxygen and give off impurities. Apparently, the plain simple purpose of respiration is twofold: (1) to get oxygen into the blood and various body tissues, and (2) to get carbonic gas (CO_2) and various other organic impurities out of the blood and body tissues. It is a common mistake to suppose that respiration is confined to the lungs. A very important portion of the true respiration occurs between the blood and individual tissue cells apart from the lungs.

Respiration includes oxidation and also elimination of waste products. This involves a double series of exchanges, one series occurring in the lungs and a reversed series occurring mainly in the tissue cells.

Continuous oxidation processes in the body result in continuous production of carbonic acid gas, urea, water, and other waste products.

Stages. — There are four stages in the complete act of respiration: (*a*) air comes into the lungs; (*b*) blood takes out part of the oxygen; (*c*) tissues take part of the oxygen away from the blood and give back to the blood carbonic gas and other materials in exchange; and (*d*) the blood trades off its carbonic gas and other materials to the air for oxygen.

Oxygen is carried to the tissues by the blood, and waste products are washed away from the tissues by the same fluid.

The blood cannot unite with sufficient oxygen or elimi-

nate its waste materials unless it is brought in contact with air. It is in the lungs that the red blood cells and serum load up with oxygen, and it is here that carbonic gas (CO_2) and other volatile impurities are eliminated from the blood. The water, CO_2, and other volatile compounds in the blood capillaries, and oxygen in the inspired air, are separated in the lungs by a thin animal membrane. Nature is constantly endeavoring there to equalize pressures and satisfy

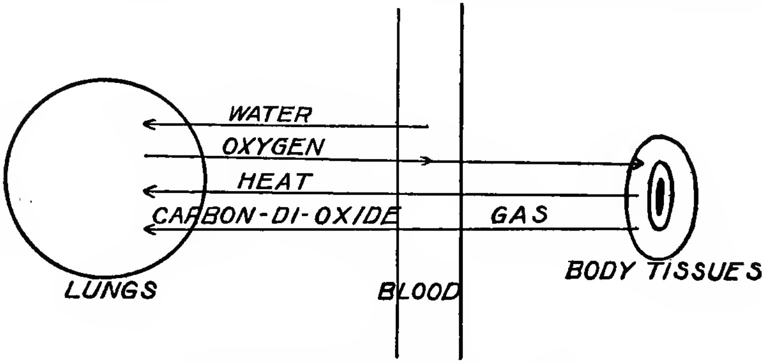

FIG. 21.—RESPIRATION IN DIAGRAM. (*M. H. R.*)

chemical affinities between free gases on one side of this membrane and gases held by a liquid on the other side of this same membrane.

Aside from chemical combination, each gas moves either away according to the partial pressure of the gas on one side and the tension of the same gas in the liquid on the other side of this membrane. The tension of the oxygen in venous blood is estimated at 22.04 mm. mercury, and pressure in lung air at about 100 mm. The tension of CO_2 in the venous blood is 41.04 mm. mercury, and in the lung air at 23 mm. These variations in pressures and tensions do not appear to account for all exchange. The living tissue cells probably interfere with the perfect working of these forces.

The factors that vary the proportion of oxygen consumed and CO_2 excreted are: body weight, amount of body surface, also rate and depth of respiration. We have the

lowest rate of respiratory change in the body, during fasting and highest rate on a nitrogenous diet.

The amount of oxygen absorbed and CO_2 developed increase rapidly with increase of body temperature and physiological activity. Muscular activity greatly increases oxygen consumption. Physiologists tell us that even shivering multiplies the respiratory changes by two, and that external cold has a similar effect.

Parts. — Respiratory system consists of nasal chambers, pharynx, larynx, trachea, bronchi, and lungs. These organs are all lined with mucous membrane. Function is to bring blood and air so near each other that the exchange may be rapid and the blood take away oxygen and leave waste matters.

Nostrils. — Two in number. These are openings at the front of the nasal cavities. The skin covering the nostrils is comparatively thin, quite sensitive, and supported by cartilages. The mucous membrane lining the nasal chambers is divided for study into two portions: the upper, in which are distributed the terminations of the olfactory nerves, and the lower, the Schneiderian.

The inferior turbinated bones are located on the outer wall of each nasal cavity, two in number, scroll shaped.

Nasal cavities. — Two in number, one on each side of a median partition. This partition is composed of the vomer, a portion of the ethmoid, and the median cartilage. Each cavity connects in front with the outside air through the nostril and behind with the pharynx through an opening which may be called the posterior nostril or, technically, the posterior nares. Each chamber also connects laterally with the sinuses of the head (shown in class). The floor, roof, and sides are formed by the various face bones, together with portions of the frontal, ethmoid, and sphenoid, and the median cartilage already mentioned.

Pharynx. — This is a muscular sac situated beneath the cranium, and back of the soft palate, which constitutes a partition between the pharynx and mouth cavities. This

organ belongs to both the respiratory and digestive systems. Its walls are composed of two coats: the inner mucous and outer muscular. It connects by openings with the nasal chambers above, with the mouth in front, and with the esophagus behind, with the lungs below, and on each side with the Eustachian tube to the middle ear.

Larynx. — A cartilaginous box located at the upper end of the trachea and composed of five pieces—one epiglottis, one thyroid, two arytenoids, one cricoid. Twelve muscles attach to these cartilages for the purpose of controlling them.

The *epiglottis* (a sort of lid) is a tongue-shaped piece of flexible cartilage which covers the entrance to the larynx. It is held down against the arytenoid cartilages when food is swallowed, but immediately afterward moves upward and thus opens the entrance to the larynx. It remains in this position during respiration.

The *thyroid* cartilage (shield-like) is located at the upper and front portion of the larynx, extending well around on the sides.

The *arytenoids* are two in number, one on each side. The two taken together are shaped somewhat like the front part of a pitcher, situated at the sides of the upper part of the larynx, coming together at the median line. These cartilages give attachments to the vocal cords.

The *cricoid* is shaped like a ring with a process on the upper and front part, which causes this cartilage to resemble a seal ring. It is located at the lower portion of the larynx and connected with the trachea.

The *vocal cords* are a pair of narrow fibrous bands so situated as to include a narrow triangular space between them. They are attached in front to the thyroid and behind to the arytenoids.

Trachea, or windpipe. — This is located beneath and in front of the esophagus. It is a long tube composed of about 50 cartilage rings beginning at the cricoid cartilage above and terminates at the bronchi below. It therefore connects

the larnyx and bronchi. It is lined by a mucous membrane which is covered by ciliated cells.

Bronchi. — Are two in number, are branches of the trachea, and very similar to it in structure and function. One bronchus attaches to the root of each lung.

Lungs. — There are two, right and left. These are the essential organs of respiration, and located in thoracic cavity. Each lung is cone-shaped and inclosed in a separate pleural sack (explained), and the other layer of the pleura lines the interior of the thorax. In the lungs of a horse the lobes are not distinctly marked. Some authors make no definite divisions; others describe the right lung as having three lobes, and the left two. The lobes are then described as anterior, middle, and posterior; the left lung in the horse having no middle lobe.

In the cow's lungs the lobes are distinctly marked. The left lung has three distinct lobes. The right lung has four lobes by reason of the anterior lobe being divided into two parts: first and second.

The bronchi are subdivided until they are very small and are then called bronchioles. Each bronchiole terminates in a very small cavity made by a lot of air cells opening together. These cells have very thin walls, and are separated by loose connective tissue in which minute blood vessels are located. Blood is then separated from the air by only a very thin membrane.

Practical application. — The student may make observations, recording fully, concerning the probable relations between external appearance of the chest and actual chest capacity. This question has frequently arisen in connection with discussions on bovine tuberculosis. Is the external appearance probably a reliable guide as to actual chest capacity? Why?

Study a skeleton or chart and note the curvature of the ribs. Bear in mind that the ribs move forward and outward during inspiration. What relation, if any, between the degree of rib curvature and possible chest expansion? What type of nostril, nasal chamber, and larynx do you usually find with great lung capacity?

LECTURE X

DIGESTIVE APPARATUS

Definition. — The digestive apparatus consists of various organs which carry on the processes of food reception, digestion, and absorption. The digestive apparatus also expels various undigested and waste materials. The organs of digestion are the mouth, pharynx, esophagus, stomach, and intestines, together with certain other organs; viz. the salivary glands at the mouth, and the liver and pancreas in the abdominal cavity.

Mouth. — At the mouth we find the lips, teeth, tongue, and palate.

The horse has a freely movable and sensitive upper lip, which is used in selecting food. The cow has hard cartilaginous lips and selects her food mainly by the tongue.

The tongue is used by the cow to select and gather her food, and by all animals to control the food while in the mouth and assist in swallowing. This organ is composed largely of muscular tissue with some connective tissue, and is covered by the common mucous membrane. Its surface is studded with several kinds of papillæ, similar to those on the human tongue. These aid in controlling the food while in the mouth and have to do with the sense of taste. They are especially prominent and strong on the cow's tongue.

The hard palate forms the roof of the mouth, and consists of portions of the superior maxillary and palate bones covered by tough connective tissue, and overlaid with mucous membrane. This connective tissue and its covering of mucous membrane is thrown up into a series of transverse ridges, easily seen on the roof of a horse's mouth, sometimes called "bars."

The soft palate is a membranous structure containing some muscular tissue. Its function is to separate the posterior opening of the nose chamber and pharynx from the mouth.

The salivary glands on each side are: one parotid, one submaxillary, one sublingual, and two molar. They secrete saliva which helps to change insoluble and useless starch into a soluble and useful sugar. It also assists in swallowing by so moistening the food that it passes easily along.

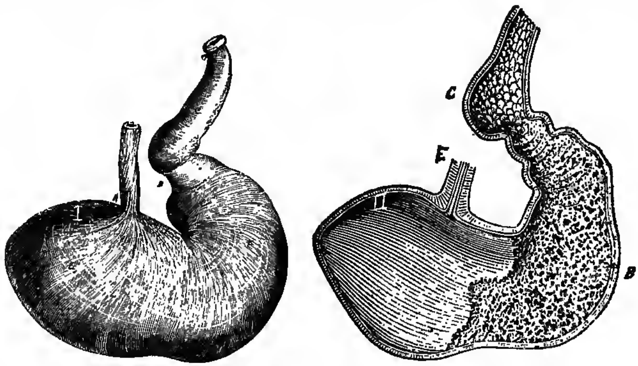

FIG. 22.—STOMACH OF THE HORSE.

1. External View. A, Esophagus; B, pyloric portion; C, duodenum; E, E, left sac; F, right sac.
2. Internal View. B, Right sac; C, duodenum; E, esophagus.

This is especially important for animals like the horse, cow, and sheep, that live upon a dry and more or less bulky food. The horse needs on an average about 85 pounds and the cow 120 pounds every 24 hours.

The *parotid* is located behind the lower jaw and below the base of the ear. It is connected with the mouth by Steno's duct, through which its saliva flows to the mouth.

The *submaxillary* lies in the space between the flat portions of the inferior maxilla, external to the larynx. Its saliva reaches the mouth through Wharton's duct, which opens at the side of that portion of the tongue where it attaches underneath.

The *sublingual* lies beneath the tongue, and its saliva

escapes into the mouth through 15 or 20 small ducts, the ducts of Rivini.

Molar glands are two in number on each side and are located near, and opposite to, the molar teeth.

The pharynx belongs to both the digestive and respiratory systems and was described in the lecture on respiration.

The esophagus is a slender tube 4 to 5 feet long, 1 inch in diameter, connects pharynx and stomach, quite elastic. It is composed of two coats. The inner is mucous membrane; the outer is muscular and composed of two sets of fibers, one set encircling the esophagus and the other placed lengthwise.

The stomach is located in the anterior portion of the abdominal cavity. The horse's stomach, when cut open, shows two distinct portions. The mucous membrane which lines the interior on the left side is light colored, firm, and tough, like the mucous membrane of the esophagus, of which it is a continuation. On the right side of the stomach the mucous membrane is soft and red. The horse's stomach holds about 3½ gallons, and the cow's stomach about 45 gallons. The function of the stomach is to receive food and furnish gastric juice to partly digest it. Stomach of the cow is compound, with four cavities. The first cavity, the paunch, is much the largest and acts as a sort of storage vat. Gastric juice is furnished by glands in right side of horse's stomach, and by cow's fourth stomach. Effect of gastric juice is to make proteid matters soluble, which it does by the action of its pepsin ferment, which is very active. The quantity of gastric juice used by horse and cow varies from 100 lbs. to 170 lbs. in 24 hours.

The small intestine. — This begins at the stomach, the common opening being guarded by the pyloris, a strong sphincter muscle like a purse string. The small intestine is divided into three parts: duodenum, jejunum, and ileum. The small intestine is about 72 feet long in the horse and 140 feet in the cow, and extends from the stomach to the cæcum, at which point the large intestine begins.

The stomach, small and large intestine have the same three coats: inner mucous, middle muscular, and outer serous.

The *mucous coat* in the small intestines is thickly studded with villi. Various intestinal glands furnish fluids which assist in digestion.

The *muscular coat* is composed of two sets of fibers, those of one set encircling the bowel, and those of the other set are lengthwise for the purpose of producing peristaltic action of the intestines.

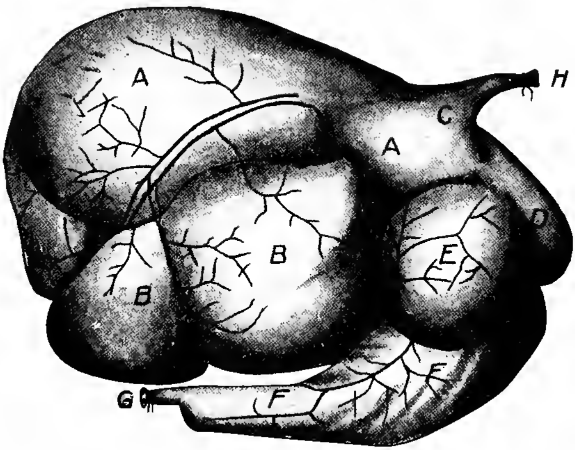

FIG. 23. — STOMACH OF THE COW.

A, A, and B, B, Different portions of the paunch or rumen; C, termination of the esophagus; D, second stomach (reticulum); E, third stomach (omasum); F, F, fourth stomach (abomasum); G, small intestine, just beyond the pyloris; H, esophagus.

The *outer coat* is the peritoneum, a serous membrane which lines the abdominal cavity and also covers the various abdominal organs.

The liver is the largest gland in the body, weighing about 11 lbs., and is situated in the abdominal cavity on the right side and well forward against the diaphragm. It manufactures about 12 lbs. of bile in 24 hours. The liver shows four fairly distinct lobes, named — the left, right, middle, and Spigelian. The liver is inclosed in a strong capsule

called Glisson's capsule. The cow has a gall bladder, but the horse has none and the bile flows more or less constantly into the intestine. The *bile* aids somewhat in digestion of fats. It has also a slight cathartic effect: it aids absorption and tends to prevent putrefaction. The liver cells convert sugar from the blood into animal starch (glycogen), and store it up as such, and finally they reconvert this glycogen into soluble sugar and give it out to the blood in proportion as the blood loses its sugar.

The pancreas, smaller than liver, weighing only 17 oz., but it furnishes about 11 lbs. pancreatic fluid daily. Located in abdominal cavity below aorta and behind stomach and liver. Ends are called head and tail. Shape is long, triangular, much like a big salivary gland. Pancreatic fluid empties into intestine at or near the bile duct. This fluid contains four different ferments: one acts on starch, one on protein, one on fats, and one curdles milk. This is probably the most important of the digestive fluids.

The large intestine is about 25 feet long in horse, capacity 33 gallons. In cow 42 feet long, capacity 18 gallons. Parts: cæcum, large colon, small colon.

Cæcum (blind pouch) in horse 3½ feet long, capacity 7½ gallons. Important in digestion of cellulose.

Large colon in horse 12 feet long, capacity 20 gallons.

Small colon in horse 10 feet long, capacity 6 gallons. In cow large and small colon are studied together, and are 35 feet long, with a capacity of 14 gallons.

Large intestine of both animals is long, large, and sacculated to hold contents a long time and offer a large amount of absorbing surface. It takes contents about five days to pass through the alimentary tract of cow, and about three days to pass through that of horse.

Practical exercise. — At this point the student may have a practical and interesting exercise by dissecting out the gullet, stomach and intestines, liver and pancreas of one or more domestic animals. Sheep and hogs are convenient to handle and very satisfactory if but one or two animals can

be used. This work may be taken up in connection with classes in " Dressing and Curing Meats " or in the dissection room. The student should actually see and handle these organs, and should measure lengths and capacities and weigh the various organs and record fully by notes and drawings.

LECTURE XI

PHYSIOLOGY OF DIGESTION

Definition. — Digestion is a chemical process by which food matters are made soluble and capable of absorption.

The digestive fluids are saliva, gastric juice, pancreatic juice, bile, and intestinal juice. These are the active agents which bring about the chemical changes necessary to make food matters soluble and absorbable.

Food groups are of two general classes: organic and inorganic.

The organic group is divided into three subgroups: *carbohydrates* (sugars and starches); *proteids* (egg albumen, casein, gluten, etc.); and *hydrocarbons* (fats and oils).

The inorganic group includes water, lime, sulphur, phosphorus, etc.

COURSE AND HISTORY OF FOOD GROUPS

Carbohydrates. — Starch cells are broken up by the teeth, and the starch is changed by the saliva and pancreatic juice into soluble sugars. Physiologists differ somewhat as to details, but during the process of digestion at least two sugars — dextrose (grape sugar), maltose, and dextrine, an intermediate body between sugar and starch, are formed. After these chemical changes comes absorption, then distribution. A large part of the starch products are taken into the portal circulation and carried to the liver. The remainder enters the general circulation. The portion carried to the liver is there changed back to a form of starch, called glycogen. As the blood loses its sugar, it is resupplied from the liver. Thus the liver becomes a storehouse

for surplus sugar and at the same time acts as a balance wheel in maintaining a uniform percentage of this material in the blood. The sugar is ultimately oxidized, liberating heat, CO_2, and water. These are excreted by the skin, lungs, and kidneys.

Proteids. — These are not affected by the saliva, but are changed to soluble peptone by the gastric and pancreatic juices, then absorbed into the blood current, and ultimately distributed to tissue cells of the body to replace worn-out parts or to build up new parts in growing animals.

It has been held that proteid matters were especially necessary to repair tissue worn out by mechanical work; but there is good reason to think that this has been overestimated in the past, and that the carbohydrates have much to do with the ultimate source of physical power.

It is probable that surplus proteids are extensively converted into fat, and stored as such in the tissues of the fattening animal, or excreted as butter fat by the milch cow or nursing mare. The remaining proteids are finally oxidized, and excreted from the body as CO_2, urea, and water. The urea is mainly excreted by the kidneys, and the water by all the excretory organs.

Fats, or hydrocarbons. — These are digested mainly by the pancreatic fluid. They are not acted on by either saliva or gastric juice and but slightly by the bile. The pancreatic fluid emulsifies a portion which reaches the lacteals in this condition. The remainder is digested by separating the glycerine from the fatty acid (fat consists of a fatty acid plus glycerine). Glycerine is readily soluble and easily absorbed. The fatty acid unites with alkaline material from the bile and pancreas to form soluble soap, and thus the remainder of the fat is absorbed. Then comes absorption of this emulsified and digested fat, distribution in the blood current, and finally assimilation, *i.e.* building into cell tissues or oxidation. It may be deposited either into and become a part of the cell bodies or it may be deposited between the cells and thus become a stored reserve.

Under some conditions this storing up of fatty matter may constitute a diseased condition, as when the heart muscle undergoes fatty infiltration. The final changes which fats undergo are oxidation and then excretion as CO_2 and water.

Practical application and suggestions. — Mature animals need a constant supply of food to supply heat and energy for physical work, and in the case of fattening animals for conversion into storage fat. Young and growing animals must have food to supply heat and energy for physical work, and in addition food from which new cells may be built.

The more thorough the digestion and absorption, the better will be the returns for food consumed.

Thorough digestion with imperfect absorption means wasted feed and useless work for the digestive organs.

Generous feeding therefore is not enough. It must be done intelligently.

Best results are secured when the bowels are in a medium condition between diarrhea and constipation.

Both digestion and absorption depend to a considerable extent upon the condition of the mucous membrane lining the digestive tube and through which absorption must take place.

Water horses before feeding and do not give more than one half pail within an hour after feeding, if you wish to get the very best results from food consumed with the least risk to health.

There is usually no profit in grinding grain for horses, unless they have poor teeth or eat rapidly, and yet the old street-car system may be practical and economical when done on a large scale, if the mechanical work can be done cheaply. This method is to cut and wet the hay or straw, then mix in the ground grain. This is a very safe method and secures thorough digestion and absorption, and in addition the horses so fed are not stuffed with hay.

Feed only as much hay at one time as the horse will clean up at each feed with the grain, approximately 10 lbs. to 15 lbs. per 24 hours. Feeders are usually surprised to find how

well their horses do with greatly reduced hay ration and the same grain. There is less danger from stomach and bowel troubles, and almost no danger at all from heaves.

Beware of dry bran for horses that eat hurriedly. They are liable to choke on it.

When an animal is choked, do not try to force any straight and stiff object down its throat. There is great danger of rupturing the esophagus near the pharynx.

The cow has an entirely different stomach as to its plan and size, and the intestinal canal is nearly twice as long. Her large paunch and the other stomachs, as well as the long intestine, indicate that she can utilize a coarser diet than the horse, and that she can digest and absorb such foods more thoroughly. They also indicate that nature intends her to eat larger quantities at a time and at longer intervals than the horse, and that the same is true as to the water she drinks.

Idle horses are frequently overfed. This is not only a waste of food but an actual injury to the horse, and gives danger of such diseases as azoturia, lymphangitis (elephant leg), and heaves.

A horse on ordinary work needs from 30 to 50 per cent more grain with the same roughage as compared with idle horses. The horse that is in high flesh and idle needs still less grain as compared with the horse that works. Horses on winter pasture, cornfields, etc., need from one third to one fourth as much grain as when at moderate work. The horse that is off work should have exercise every day if possible. Exercise lessens very much the danger from many diseases.

LECTURE XII

URINARY ORGANS AND MAMMARY GLANDS

URINARY organs are kidneys, ureters, bladder, urethra.

Kidneys. — These important organs are situated in the sublumbar regions, supported in place by large blood vessels and connective tissue. They differ in shape, size, and location, the right one being larger, farther forward, and more nearly round. Each is covered by a fibrous capsule from which bundles of connective tissue branch to penetrate the organ and form a framework.

Internal structure. — On cutting open a kidney we may see two distinct portions separated by a wavy line, and a cavity at the root. The two portions are cortical (outside), medullary (center).

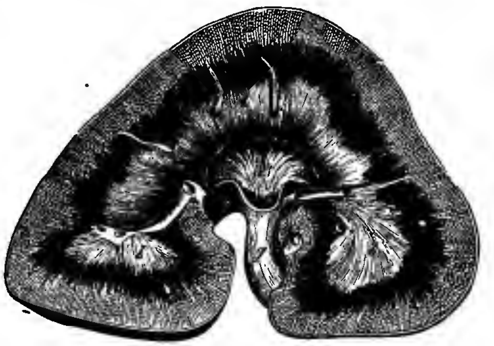

FIG. 24. — LENGTHWISE SECTION OF THE HORSE'S KIDNEY.

a, Cortical portion; *b*, medullary portion; *d*, *d*, *d*, pelvis; *g*, ureter.

The cavity at the root, called pelvis, is merely the funnel-shaped origin of the ureter.

The arterioles terminate and the urine tubules have their origin in the cortical portion. These little urine tubes make up a large part of the bulk of the kidney. Each tubule begins somewhere in the cortical portion in a little saclike cavity, within which is a tangled network of finest arterioles.

The little sac narrows at the open end, and from this narrowed neck continue the tubules. Each tubule makes certain convolutions, then descends to the medullary portion, thence back to the cortical, where it makes certain other convolutions, and finally terminates in a larger duct through which the urine escapes to the pelvis of the kidney and then into the ureter. Each tubule is thus very long in proportion to its size, and there are a large number of them.

Function of the kidneys: (*a*) Removal of useless or waste and poisonous materials from the blood; (*b*) removal of normal substances from the blood when they are there in excess; (*c*) to keep the blood normally alkaline by removing from or adding alkaline materials to the blood as needed.

How accomplished. — The water and salts in solution are removed from the blood within the little sacs at the beginnings of the tubules by a process of filtration under pressure, the pressure on the blood, inside the fine arterioles within the urine tubule sac, being greater than the pressure on the water in the sac around the arterioles. The urea, albumen, etc., are passed out into the water farther along the tubule. These are taken from the blood by the cells which line the tubules.

Composition. — Urine is composed of water, salts of sodium, potassium, calcium, etc., together with various organic matters, as urea and uric acid, and various aromatic substances which give the odor. Normal reaction in herbivorous animals is alkaline. Specific gravity for horse is 1036, and for cow 1025. Either may vary within the normal range. Horse excretes about 10 pints in 24 hours, and the cow about 25 pints. Within limits the more nitrogen in feed of cow the greater amount of urine is excreted. Urine is excreted by the kidneys continuously and runs drop by drop into the bladder.

Ureters. — These are two slender tubes which conduct urine from kidneys to bladder. They are about the size of a goose quill, about one foot long, and terminate at the

bladder, passing for an inch along between the muscular and mucous coats of that organ, before reaching the interior. This is to prevent backward flow of urine into ureters.

Bladder. — This is a muscular sac, a urine reservoir, located in the inferior and anterior part of the pelvic cavity and ovoid in shape. This organ is supported in place by a variety of ligaments. It is in relation above, in the male, to the rectum; in the female, to the vagina and below to the floor of the pelvis. It is covered in front by peritoneum and is in relation to the coiled small intestine.

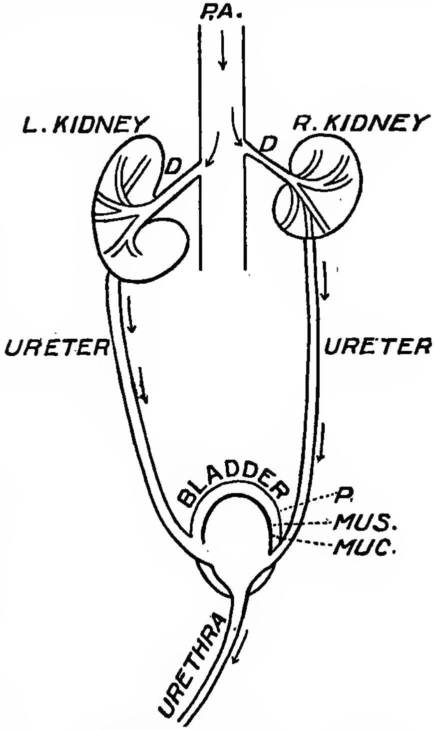

FIG. 25. — URINARY APPARATUS IN DIAGRAM. (*M. H. R.*)

P, A, Posterior aorta ; D, D, renal arteries ; P, peritoneal coat of bladder ; Mus., muscular coat ; Muc., mucous coat.

Openings. — Three on the posterior of the organ; viz. one to the urethra, and two for the ureters. The neck of the bladder is composed of a band of yellow elastic tissue around urethra and is pulled open by longitudinal muscle fibers when urine is to be passed. There are no distinct sphincter or muscle fibers at the neck.

Coats. — Three: mucous, muscular (of several layers), and serous (peritoneal).

Urethra. — This is the canal which conducts urine from bladder to exterior of body.

MAMMARY GLANDS

The cow's udder is taken as a type. The glands are located under the inguinal region and supported by skin, loose connective tissue, and bands of white fibrous tissue which attach to the fibrous tunic of the abdomen and act as ligaments to help support the organ. The udder is covered by thin, soft skin and fine hair.

Anatomy. — The udder is divided into two lateral halves. Each half has two glands, front and back, and each half is incased in a fibrous sac of yellow elastic tissue.

FIG. 26. — ONE QUARTER AND TEAT OF COW'S UDDER. (*O. K. C.*)

C, milk cistern. Note constriction just below the cistern. Another constriction at end of teat. Holes, shown in the gland above, are milk ducts cut across.

The substance of each gland is made up of yellow glandular tissue, connective tissue, nerves, blood vessels, etc. Each gland is divided into lobes, and these again into lobules.

There is one small milk duct for each lobule. These unite into larger and larger ducts, and thus the milk is conveyed into the milk cistern.

A milk cistern is located just above the base of each teat. This receives milk from the milk ducts — capacity, 1 pint to 1 quart. Milk escapes from cistern through a single large canal.

Development. — The gland structure is undeveloped and rudimentary until maturity, and only becomes active at the close of the first pregnancy.

Function. — Natural function is supplying sufficient milk to the calf until it can subsist on other foods.

Milk production. — The production of the casein, sugar, fat, etc., is a manufacturing process, not mere filtration; for there is no casein or milk sugar in blood and but very little fat. Secreting cells take certain elements from the blood and put them together so as to make the milk ingredients.

Products. — *Milk* is a complex alkaline fluid; specific gravity 1018 to 1040, composed of oil globules suspended in milk plasma, and is therefore an emulsion. Milk globules consist almost entirely of fat, with a thin coating of casein. They are from .0004 to .0012 of an inch in diameter. Milk plasma consists of water, with sugar, salt, albumen, and whatever may be in solution in the water.

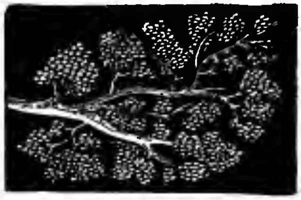

FIG. 27. — MILK VESICLES AND OUTLET DUCTS. MAGNIFIED.

Colostrum is a fluid which accumulates in the udder during the latter part of pregnancy, and differs from milk in containing the colostrum cells, a few oil globules, much albumen, and but little casein, fat, or sugar. It has a mild, cathartic effect on the young animals.

The quantity and quality of the milk depends on several factors: food, period of lactation, period of gestation, condition of the nervous system, quantity of blood passing through the udder, amount of water in the food, individual peculiarity, or hereditary tendency. Breed would naturally be included under the latter.

Blood supply. — The mammary glands receive their supply through the mammary artery, which distributes branches through the two glands in each half of the udder, one artery on each side. The blood for one half the udder thus comes through the external iliac artery, then through a branch of that, the prepubic, and then through a branch of the prepubic, the external pudic.

The *mammary artery* is one of the terminal branches of the external pudic. When the cow stands still, more blood flows through the udder than when she is exercising. The large vein which may be felt in front of the udder on each side, and called by dairymen the " milk vein," is properly the subcutaneous abdominal vein.

Nerve supply. — The mammary glands have their nerve supply through the first lumbar pair of spinal nerves. The

nerve trunk which reaches the gland on each side divides into three branches, the second and third of which regulate in an interesting way the various phenomena of cell activity, blood supply, and caliber of the milk ducts. These processes are all directly under control of the nervous system.

Why last milk drawn is richer in fat than the first: There is a comparatively small amount of milk stored in the cisterns and ducts when milking begins, and then as milking goes on the secreting cells manufacture the fat, casein, sugar, etc., more rapidly in proportion than the process by which water and matters in solution are taken from the blood, and thus the later milk has less water or more solids than the first drawn.

Practical suggestions. — Mare's milk differs from cow's milk in possessing more water and sugar and less fat, casein, albumen, and mineral matter. Her udder differs from the cow's udder in having but one gland in each half. There are from two to four cisterns at the base of the teat instead of one, and each cistern has an excretory canal to the point of the teat.

A cow's udder may consist largely of gland tissue with just enough connective tissue to support it and hold shape; it may consist largely of connective tissue with a relatively smaller amount of gland tissue. What is the probable structure of the udder that remains large and hard after milking? What are some of the reasons why small udders may produce well and large udders produce poorly?

Note the large vein running from under the udder forward under the belly. This is the abdominal subcutaneous vein previously mentioned; it varies greatly in size and shape, and drains the inguinal region, including the udder. What possible relation is there between the size of this vein and milk-producing capacity of the udder?

What effect has unusual nerve excitement on the production of milk? Explain this effect.

LECTURE XIII

THE FOOT

THE foot, technically, includes all structures at and below the knee in front and the hock behind. This lecture only deals with that portion of the foot below the ankle.

Bones. — First phalanx; two sesamoid bones; second phalanx; navicular bone; and third phalanx. For first and second phalanges, sesamoids, and navicular, see Lecture III.

FIG. 28. — BONES OF THE HORSE'S FOOT.

1, Metacarpal; 2, 2, sesamoids; 3, first phalanx; 4, second phalanx; 5, navicular bone; 6, third phalanx (os pedis); 7, basilar process; 8, 8, wings; 9, pyramidal process.

The *third phalanx* is an irregular bone of loose spongy texture. The body is shaped somewhat like the hoof and shows at the top in front a prominence called the pyramidal process, and on each side a projection called the wing, under which may be seen a groove, through which groove an artery passes on its way to form part of an arch within the substance of the bone. From this arch is given off the branches which distribute nourishment to the vascular parts. Above the wings, inside the hoof, are cavities into which the lateral cartilages fit. They are of firm cartilage and may be felt above the crown of the hoof on each side. They are attached below to the

wings of the third phalanx and plantar cushion. To the front and sides of the third phalanx are attached the sensitive laminæ. The inferior surface is concaved to receive the sensitive sole, or velvety tissue.

The *navicular bone* is also a sesamoid bone; *i.e.* it is formed in tendon. It is a short bone in structure, but rather long and slender in shape, and placed crosswise just back of the articulation between the second and third phalanges. Its inferior surface is smooth except for a slight ridge in the center. The tendon of the deep flexor muscle passes over this surface on its way to its insertion on the bottom of the third phalanx. The ends of the navicular bone unite on each side with the wings of the third phalanx by tough fibrous tissue.

The horny hoof. — This is to be regarded as an appendage of the skin. It covers all of the third phalanx and part of the second. It is divided for study into wall, sole, and frog.

The *wall* is that part which may be seen when looking at the hoof in front and at the sides. It is composed of horny, tubular fibers, which grow from the coronary band. Between these tubular fibers is a material which holds them together. The wall is divided into toe, quarters, and heels. At the top is a groove into which the coronary band fits, the crown of the hoof. The wall unites below with the sole. The smooth shining layer which should cover the whole surface of the wall is periople. The duty of this layer is to prevent undue evaporation from the hoof. Beneath the periople is the horny wall which gives shape to the foot and protects the soft parts within. Inside this hard layer come the laminæ; these are thin leaves of horny material which dovetail in with the sensitive laminæ.

The *sole* is composed of horny material resembling that of the wall. It is concave below, convex above. Its outer border unites with the wall at the "white line." Its upper surface is covered by the vascular velvety tissue.

The frog is a V-shaped elastic pad with a depression, called by horsemen "the cleft," in its ground surface. It is

located between the bars on each side, and below the plantar cushion. Its function is to act as a pad and to lessen jar when traveling.

The matrix (horn-generating membrane). — This fits inside the horny part of the hoof and covers like a stocking the other parts within the hoof. It is from this that all the

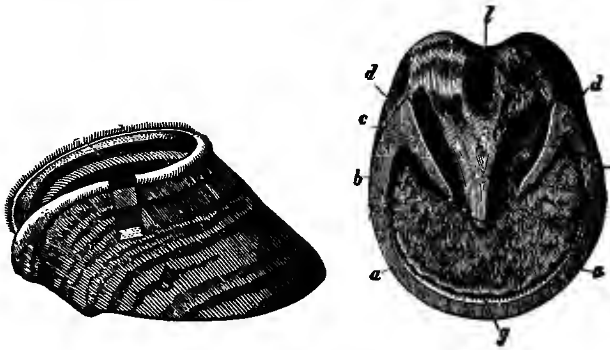

FIG. 29. — THE HOOF.

The Wall. A, Toe ; B, quarter ; C, heel.
Ground Surface. *a-a*, Toe ; *a-b*, quarter ; *b-d*, heel ; *c*, bar ; *f, f, f*, sole ; *g*, white line ; *h*, frog ; *l*, cleft of the frog.

horny parts grow. It is composed of three parts: (1) coronary band; (2) sensitive laminæ; (3) velvety tissue.

The *coronary band* is the elastic ring that may be felt at the crown of the hoof. It is studded with little papillæ. From these grow downward the tubular fibers which make up the hard layer of the wall.

The *sensitive laminæ* are 500 to 600 layers of vascular tissue into which fit and from which grow the horny laminæ of the wall. An inflammation here is called laminitis or founder.

The *velvety tissue* covers the upper surface of the hard sole. Like the coronary band and sensitive laminæ, it is sensitive and richly supplied with blood. The under surface is thickly studded with papillæ, similar to those of the coronary band, and from these in a similar way grow the shorter tubular fibers which make up the hard sole and frog. The student can easily understand why injury to the coronary

band, which results in a healing by scar tissue, leaves a split which lengthens downward in the hoof; why founder is so painful; and why deep injuries to the sole are so apt to be serious.

The plantar cushion is a wedge-shaped mass of elastic tissue located between the lateral cartilages on each side, below the sole of the third phalanx and above the horny sole of the hoof. It assists the horny frog in lessening jar in travel and protects the insertion of the deep flexor tendon.

"**The back tendons**" is a term used by horsemen to include the tendons of the superficial and deep flexor muscles of the foot and the suspensory ligament.

The *superficial flexor muscle,* of the front foot, has its origin on the lower end of the humerus and its insertion by tendon on the sides of the second phalanx. Its function is to flex the foot at the first interphalangeal articulation.

The *deep flexor muscle,* of the front foot, has its origin in common with the superficial flexor on the lower end of the humerus, and its insertion by a tendon which spreads out on the sole of the third phalanx. Its duty is to flex the second and to assist in flexing the first interphalangeal articulation.

The *suspensory ligament* is broad and very strong. It attaches by its upper end to the carpal bones and to the large metacarpal. Its lower end divides into two branches which pass forward on each side and attach to the front tendon. Its duty is to support the metacarpo-phalangeal articulation (fetlock).

PRACTICAL APPLICATION

The shape and peculiar characteristics of each hoof correspond in correlation with the remainder of the limb, except as the hoof has been varied by artificial means. So in judging the hoof it is also necessary to consider the characteristics of the entire limb.

The front limb may be said to be normal in position and direction when it appears on front view that a vertical line from the front of the scapulo-humeral articulation passes

down the center of the limb and to the ground at the center of the toe.

On viewing such a limb from the side it should be evident that a vertical line downward from the bony prominence at the middle of the scapula would divide the external surface of the limb into two equal portions and reach the ground immediately back of the heels.

Fig. 30.—The Hoof Matrix.

1, Periople ring; 2, coronary band; 3, sensitive laminæ; 4, heel. Velvety tissue not shown on the sole.

Viewing the hoof and pastern alone it should be seen that the hoof is in direct line with the pastern and metacarpal or metatarsal bones, and that a line extending from the center of the cannon through the center of the pastern would pass through the center of the toe.

The hind limb when viewed from behind should show that a vertical line downward from the prominence at the posterior portion of the pelvis on each side (tuberosity of the ischium) would divide the entire limb into two equal portions and reach the ground back of the center of the horny frog.

Viewed from the side the normal hind limb should indicate that a vertical line, dropped from the prominence of the articulation between the femur and pelvis, should reach the ground opposite a point near the center of the hoof. This line is somewhat difficult to get, and of less value for the reason that a slight leaning forward or backward disturbs it. This should be taken when the horse is standing with the limb squarely under the body in a natural position for the particular animal examined.

For the front hoof the wall at the toe and the anterior surface of the pastern should make an *angle* of not less than 45 nor more than 50 degrees with the level ground

surface, the wall at the toe and the anterior surface of the pastern having the same slant.

For a normal hind hoof the *angle* should be from 50 to 55 degrees, and the anterior faces of the hoof and pastern should still have the same slant.

A normal hoof has a good quality of horn, wide *heels*, and circular rather than long and narrow ground surface. The hind hoof is narrower and more pointed at the toe than the front hoof. The *wall* from coronary band to ground surface should be straight and smooth; *i.e.* no ridges or grooves. The *heels* should be rounded, well developed, and of the same height at the top of the coronary band. The *sole* should be distinctly concave and show no marked separation from the wall. The *frog* should be large and elastic, the two portions of the same size, with a shallow groove along the center. The *bars* should be straight, extending forward and inward. The *lateral cartilages*, felt above the coronary band on each side, should be elastic. The sole in the angles between the bar and the wall at the heel should not show red stain. There should be no separation of the horny fibers as in toe or quarter cracks. The wall should be reasonably thick. This can be usually determined by tapping the wall with a hammer, noticing its rigidity.

LECTURE XIV

PATHOLOGY

Physiology is the study of the body organs and their functions in health.

Pathology is the study of diseased organs and their disordered functions. Healthy conditions are taken as a basis for studying the diseased conditions. Pathological processes are but healthy ones modified.

HYPERÆMIA CONGESTION

Definition. — Hyperæmia is an abnormal accumulation of blood in any part, due either to an increased inflow or a decreased outflow. The color of an hyperæmic part may be distinctly red in active hyperæmia or bluish in passive hyperæmia.

There are two kinds of hyperæmia, active and passive. Generally speaking, both types are local conditions.

Active hyperœmia is characterized by an excessive quantity of blood in the arteries of some tissue or organ. It is caused by agencies that produce dilation of the arteries, as body temperature disturbances, chemical irritants, etc. It may be the result of lack of blood elsewhere in the body; *e.g.* sudden chilling of the skin of a horse frequently produces active hyperæmia of the lung or other internal organs. Active hyperæmia is usually temporary, and permanent injury may be slight or may not occur. An active hyperæmia may lead, if long continued, to enlargement of the part or organ. The vessels themselves may enlarge to several times their former size.

Passive hyperœmia (venous or mechanical) is a condition in which the current of venous blood is obstructed and

blood accumulates in veins and capillaries. The condition may be due to weakened heart action or to obstruction in veins, and less frequently to obstruction in arteries or capillaries. Some of the local changes that may follow passive congestion are exudation of serum, abnormal development of connective tissue, clots in the vessels, or local tissue death.

ANÆMIA

Definition. — Anæmia is an abnormal condition characterized by a deficiency or poor quality of blood. Anæmia due to deficiency may thus be either general or local; if to poor quality, it is always general.

General anæmia. — This refers to a state of ill health characterized by general lack of blood — usually to lack of red blood corpuscles or lack of other constituents. This may be caused by hemorrhage, poor nutrition, destruction of red cells, or disease of blood-forming tissues.

Local anæmia. — Local anæmia may be due to: (*a*) pressure upon the part; (*b*) contraction of arteries supplying this part; (*c*) excessive blood elsewhere in the body; (*d*) cold or chemical agents.

Results. — Anæmia results in general in tissue starvation and deprivation of oxygen. Its seriousness depends upon its extent, location, and duration. Anæmia may be very serious in vital organs or much less important in such organs as the skin and muscles. During anæmia, nutritive changes are restricted and the processes of excretion are checked. Waste products therefore accumulate.

Complete and persistent anæmia results in death of the tissue (necrosis).

INFLAMMATION

Definition. — Inflammation is the response of a tissue to an injury. It is a complex pathological process consisting of disturbances of circulation, and constructive and destructive tissue changes. Pain, heat, redness, and swelling are the cardinal symptoms of inflammation.

The changes which occur in the blood vessels during inflammation are: (1) dilatation of arteries, capillaries, and veins; (2) current velocity increased at first, then decreased; (3) when the velocity begins to decrease, the corpuscles collect in capillaries and small veins and the white corpuscles adhere to their walls, thus obstructing the blood current; (4) both kinds of corpuscles and the blood plasma may pass through walls of small veins and capillaries.

The changes of an inflamed tissue are variable. In the beginning of an inflammation the causing agent produces cell degeneration, and in some instances cell death, whereas in the later stages of inflammation there may be cell multiplication and construction of tissue; *e.g.* healing of a wound.

Inflammation varies according to (*a*) resisting power of tissue, (*b*) activity of cause, (*c*) length of time cause is in action.

Causes of inflammation are: (1) Mechanical injury, chemical action, excessive tissue activity, extremes of heat and cold, etc. Inflammation thus caused has little tendency to spread beyond the part injured, and there is usually little or no pus unless pus germs invade the inflamed area.

(2) "Microbes," "microörganisms," "bacteria," and "germs" are synonymous terms as commonly used. These can cause inflammation without the aid of other local injury. Inflammation may be caused directly by their mechanical presence and activity, but it is more commonly caused by chemical agents which the germs manufacture.

Terminations. — Inflammation may terminate in (*a*) resolution, (*b*) death of the tissue, or (*c*) new growths.

Resolution. — In this case the exudate is liquefied and removed by the lymphatics and veins, or it is carried out by leucocytes (white corpuscles). The blood current then starts again in the small vessels; the corpuscles move away in the reëstablished current or else become degenerated and then removed, and the organ or tissue becomes normal again.

Local death. — If death of the part occurs, tissues may be dissolved and absorbed or the part may slough. In either case the inflammation may extend to and involve surrounding tissues, and thus the life of the animal may be ultimately destroyed.

If new growths occur, there develop new tissues; *e.g.* tumors, granulations in a wound, and scar tissue.

FEVER

Definition. — Fever is an abnormal condition characterized by an excess of heat in the body. It is not a disease, but merely a symptom of disease.

Cause. — Any disturbance that causes an increase of heat production or decrease of heat loss, usually the former. Fever should be distinguished from overheat; the former is an increased body temperature due to increased heat production or decreased heat loss, and the latter is an excessively high body temperature not the result of disturbance of heat production or heat dissipation, but caused by absorption and accumulation of heat from without. The normal temperature of horse is 100 to 101.5 degrees F. One hundred and four degrees F. is called high, 106 degrees F. very high. Normal temperature of adult cattle varies from 100 to 102.5 degrees; of sheep from 100 to 104 degrees. Nervous system has control of both heat production and heat loss. The body temperature is therefore a balance or relation between heat production and heat loss.

Heat production. — The source of animal heat is the oxidation of body tissue and fuel materials in the blood and the consequent breaking up of complex chemical compounds into simpler ones. The principal heat-furnishing organs are the muscles and secreting glands.

Heat expenditure. — Body heat is normally expended about as follows: warming food and drink, 2 per cent; warming air in lungs, 5 per cent; evaporation from lungs, 8 per cent; evaporation of moisture from the skin surface

and radiation from skin, 85 per cent. The expenditure of heat in evaporation of moisture from the skin surface is very much larger than either of the others. On an average there is sufficient heat developed daily in a body of a medium-sized horse to raise 4550 gallons of water 1.8 degrees F.

Symptoms of fever. — (*a*) Elevation of temperature; (*b*) dry, hot skin (not always present); (*c*) pulse and respiration quickened (normal pulse of horse, 36 to 45; normal respiration 8 to 14 per minute); (*d*) scanty urine; (*e*) loss of flesh.

Kinds of fever. — Classified according to course are: (*a*) *continuous*, with but slight variation; (*b*) *remittent*, varies greatly during the day, but does not get down to normal; (*c*) *intermittent*, in which the temperature varies at different portions of the day and reaches normal at a certain time each day; (*d*) *relapsing*, fever comes at certain intervals, with a period of one or more days of normal temperature between.

Stages of fever. — (*a*) The initial, or beginning; (*b*) the acme or highest point; (*c*) decline. The initial stage may be either short or long, according to the patient and disease. The decline may be slow or rapid.

Results. — (*a*) Emaciation, or general atrophy, more or less severe, according to the duration and height of the fever, and caused by continued unusual oxidation of body tissues; (*b*) death may occur; or (*c*) recovery. Death may occur suddenly, or the final changes may occur gradually. The recovery may be partial or complete, slow or rapid, depending on: the nature of the disease of which the fever is a symptom or condition; the native vigor or vital constitution of the patient; and the conditions under which the patient is kept and under which the disease runs its course.

LECTURE XV

PATHOLOGY—*Continued*

Hemorrhage is the escape of blood from its natural channels.

Causes. — (1) Injury to the vessel walls, as when cut or torn; (2) diseases of the vessel walls, *e.g.* fatty or calcareous degeneration; (3) excessive blood pressure inside the vessel, as in hypertrophy of the heart with excessive strength and activity, resulting in rupture of the vessels; (4) change in the quality of the blood with weakness in the vessel walls.

Dropsy is any abnormal collection of serous fluid in any cavity or tissue of the body. This may occur in the abdominal cavity, in the chest cavity, ventricles of the brain, or in loose tissues under the skin. Of those places outside the large cavities, the most common are the limbs and lower portions of abdomen. Dropsical fluid is usually of pale straw color, nearly neutral in chemical reaction, and slightly heavier than water.

Cause of dropsy. — (1) Any local increase of blood pressure; (2) any interference with flow of blood in the veins; (3) obstruction in capillaries, which is quite common in diseases of the liver or kidneys.

Dropsy may be either general or local.

General dropsy may affect the subcutaneous connective tissue over a large area, and any of the serous body cavities. It may be due to conditions associated with anæmia, heart trouble, or kidney disease.

Local dropsy is limited to some one organ or cavity, and may be due to local mechanical obstruction in the veins or lymphatic vessels.

Hypertrophy is any enlargement of any part or organ of the body. It may be due to either an increase in the num-

ber of elements, or an increase in the size of existing elements, or to a combination of two conditions. Hypertrophy may be either physiological, healthy, or pathological, diseased.

Physiological hypertrophy is illustrated in the blacksmith's arm, where there is enlargement of muscles, due to an increased exercise and therefore increased nutrition to the muscles. If one kidney be removed, the other enlarges to compensate.

Pathological hypertrophy is illustrated in "elephant leg" of horses, a condition in which the connective tissue of the skin and underlying parts increases in quantity, resulting in enlargement.

In any hypertrophy the newly formed elements are more nearly like the normal when the circulation is most vigorous.

Atrophy is the opposite of hypertrophy and is characterized by decrease in bulk and weight, as, for instance, sweeny of the shoulder muscles in horses. Atrophy may be general or local, and the decrease in size may be due either to decrease in size or number, or to decrease both in size and number, of the elements.

Local atrophy may be caused by: (1) decreased amount of blood and decreased nutrition; (2) nerve disturbance which sometimes results in very rapid atrophy; (3) inflammation; (4) excessive activity and exhaustion of the tissue elements; (5) continuous pressure.

General atrophy may be caused by lack of nutrition or excessive consumption and wastages of the soft tissues, especially the fats which are first taken; *e.g.* in typhoid fever in the human, or influenza in the horse. In this sense general atrophy is synonymous with emaciation.

Degenerations and infiltrations are characterized by changes in the quality of a tissue; the bulk may or may not remain the same. When tissue degenerates, cheaper material is deposited in and actually becomes a part of the tissue. This is degeneration. When infiltration occurs, the lower grade tissue is deposited in the cells and between the fibers or other tissue elements. The proper elements may

then shrink. The affected organ loses in usefulness in either case.

Fatty degeneration is characterized by the formation of fatty matter in the tissue elements, and is especially common in muscular and glandular tissue.

Fatty infiltration is characterized by a deposit of fatty matter between the tissue elements and later into the tissue cells. Either may be caused by (1) deficiency of blood and consequent imperfect nutrition; (2) inflammation; (3) high fever; (4) poisons, like phosphorus, arsenic, antimony, etc.

Calcareous degeneration and infiltration are marked by deposit of lime salts into or between the tissue elements, and may be caused by anything that results in imperfect nutrition and lessened vitality. These conditions occur more frequently in the tissues of older people or animals. The muscular coat of the arteries sometimes becomes calcified and brittle in old people and may even break under some unusual strain.

There are various other degenerations and infiltrations besides these two named; but in each case there occurs the deposit of some inferior tissue into or between the proper elements of the organ.

Collapse. — The symptoms are: temperature below normal; surface of body cold; respirations very shallow and slow; pulse feeble and very slow or very fast.

Collapse may be the result of (*a*) a very high fever, (*b*) poison, (*c*) suppression of secretion or excretion, (*d*) rupture of internal organs, (*e*) excessive hemorrhages, (*f*) decomposition of the blood.

Syncope is suspension of heart action. It is more sudden and the symptoms are more brief than in collapse.

Death is permanent arrest of all functions. It begins at heart, lungs, or brain. Heart failure (syncope) is very sudden. Lung failure results in suffocation or asphyxia. Brain failures develop slow symptoms, stupor being present. When death occurs because the blood is altered, the heart first ceases action.

LECTURE XVI

WOUNDS

Definition. — A sudden break in the continuity of a tissue, caused by external violence.

Healing. — All wounds heal by the production of new cells and new intercellular substance formed from preëxisting tissue cells. The embryonic cells change later into mature cells like those of the adjacent tissue. Complete union implies a restoration of circulation and nutrition. This again implies new blood vessels for the new tissue.

Union by primary intention. — The essentials of this mode are rapid union and absence of germs and pus. All wounds which heal without suppuration heal in this way. There is always some new tissue formed, although it may not be visible.

By granulation. — This is observed in the healing of open wounds, and consists of the formation of new tissue by the multiplication of preëxisting cells. This new tissue fills the space between the wound margins and replaces the tissue that was destroyed.

Newly formed tissue in open wounds is composed of capillaries, embyronic connective tissue cells, and leucocytes. If the wound is free from germs and the surfaces are kept at rest and close together, healing is very rapid and but little new tissue needed. Where there is loss of much tissue, it may be impossible to bring the surfaces together and a great deal of new tissue is needed. Connective tissue cells only develop from preëxisting connective tissue cells, — epithelial from epithelial, bony from bony, etc.

When wounds are covered with granulations, each little

elevation contains a loop or network of new blood vessels. The white blood corpuscles emigrate through the new blood vessels and form part of the pus when this is present. Healthy granulations are small, firm, pink in color, and the surface is slightly moistened with a colorless fluid. In this case the wound heals rapidly and usually leaves a small scar.

Proud flesh is merely a mass of profuse granulations, and indicates either a lack of vitality or else external irritation. The latter is usually from germs.

Development of new blood vessels. — This is from vessels that previously existed in the injured tissue. The growth of new blood vessels and new tissue for union start together and continue until enough granulation tissue has been developed to fill the wound gap. The new vessels start by budding from capillaries near the surface, and are always short. These buds project farther and farther and gradually change into threads. These threads gradually hollow into tubes, beginning at the end near the old capillary. It happens frequently that the ends of two neighboring projections meet and unite to form an arch. As this becomes hollowed out a capillary loop is formed. When this development is complete, then new blood vessels may start from this one and perhaps develop another arch. The thread-like projections are probably hollowed out by the blood current in the parent vessel.

Granulation tissue is more vascular than normal tissue. Useless vessels are finally constricted and then obliterated.

Inflammation in wounds is due to foreign material; for instance, dead tissue or foreign bodies, but more commonly by germs which by multiplication give rise to wound infection and inflammation.

Osseous tissue. — Wounds in bone tissue heal like those in other tissues, the wound surface being covered with granulations. The development of new tissue is from the periosteum and from the marrow at the place of injury. At the

end of a few weeks, the ends are united by a spongy mass beneath the periosteum and in the medullary canal. This mass gradually becomes organized. This is called a callus and later is partly removed.

Cartilage has very little power of repair. Loss of cartilage is generally repaired by fibrous connective tissue.

Nerve tissue. — After a nerve is cut, the severed portion degenerates. New axis cylinders come down from the stump and grow through or along old sheaths of the severed portion. It is doubtful whether primary union ever takes place. Quick return of sensibility does not necessarily imply restoration of the injured fibers. The newly grown axis cylinders receive sheaths which probably grow from nerve cells lying within the old sheaths. Whether the new fibers ever reach the old terminals depends upon the amount of intervening tissue and the density of it. The limit of growth is placed at from one to two inches.

The new tissue. — In certain tissues, extensive injuries may be repaired by tissue which completely resembles the original. This is true of tendons and bones. Muscular tissue seems to have much less ability to repair extensive injuries. Scar tissue contracts for a long time after healing is complete. The scar is large when there has been more granulation tissue than needed or where an extensive removal of tissue necessitates a great amount of scar tissue. Scar tissue in this case is endowed with low vitality, and is poorly nourished.

How skin recovers a surface. — A wound is not entirely healed until it is recovered. This takes place by development of new epithelial cells from those of the skin. These new epithelial cells gradually form new skin which grows from the margin. It covers the granulations loosely at first, but later unites firmly to them. New epithelial cells have the power of amœboid movement. They may become detached from the margin and set up a new covering center elsewhere on the wound surface. Restoration of the skin surfaces, and for that matter the entire healing, is favored

by surgical cleanliness, and is hindered by irritating medicines, and by rubbing sponges, etc., over the surface.

An exception should be noted, viz. that when healing has ceased in case of an old sore, with the surface not yet covered by skin, healing may sometimes be given a vigorous start by a blister.

LECTURE XVII

WOUNDS—*Continued*

THE most common wounds which affect stock are those caused by barbed wires, plows, harrows, etc., and are generally large and badly torn. The farmer rarely has to deal with a nice clean wound that can unite smoothly and heal rapidly.

Bad treatment. — Nearly every farmer has some special preparation which he thinks of great value in the treatment of wounds. Most of these preparations are seriously injurious, and greatly retard healing. Various preparations of turpentine, alcohol, vinegar, carbolic acid, irritating oils, and even the mineral acids are frequently used in the treatment of these wounds, and then, because the patient recovers in spite of barbarous treatment, people erroneously conclude that the medicine cured.

Bleeding. — This can usually be checked quite easily. If the blood comes from a large number of small vessels, the hemorrhage can be checked and finally stopped by means of ice, by very cold or very warm water, or the wound may be packed with clean cotton or oakum and tightly bandaged. In case a large blood vessel is severed, it may be better to draw the end out and tie a strong thread around it. The artery may be secured by means of small forceps or even with a hook made by bending a pin or piece of wire.

In some cases hemorrhage can be easily controlled by a tight bandage placed above or below the wound. If the blood flows in a steady stream, the bandage should be on the side farthest from the heart. If it flows in jets, the bandage should be tied between the wound and the heart.

Sewing. — Comparatively few wounds are materially bene-

fited by sewing, bandaging, or washing except in professional hands. If the wound is made lengthwise of the muscle, there may be considerable advantage in holding the sides together by sewing. No special form of needle or thread is necessary except that both should be clean, and the latter should be of reasonable size. A darning needle and ordinary white cotton thread or twine will do very well in an emergency. But if the wound is made across the muscle and gapes widely, it is usually unwise to sew, for the sutures will cut out in a few days and make the scar much worse than if it had been left alone.

Bandaging. — Occasionally a wound is such that the edges can be held together by means of bandages. If this can be done, there may be considerable advantage in so doing, but these wounds are rare. Bandages must be changed frequently and the wound kept clean.

Fig. 31. — Badly Treated Wire Wound. (*M.H.R.*)

Washing. — Few of these wounds are benefited by washing or other "home" treatment. If a wound is such that pus can drain from it freely and as rapidly as formed, there is little to be gained by washing. If on the contrary there are deep recesses or pockets from which the pus cannot drain, then the wound must be so altered that these pockets will drain or else they must be washed out; otherwise the pus may burrow deeper.

Carbolic acid is commonly used so dilute that it is without effect. When used strong enough to be distinctly antiseptic, it becomes injurious to the wound surface. If

washing is necessary, use warm water containing a trace of salt, just enough salt so that it can be tasted. This is efficient and not injurious. In any case the wound surface must not be rubbed over during the process of washing.

Dry treatment. — Sometimes quicker and better results can be obtained by the use of nonirritating and astringent antiseptic powder; for instance, the following: iodoform, boracic acid, and tannic acid, in equal parts. This may be dusted over the surface once daily to produce an artificial scab. If the wound is suppurating freely, it may be advisable to irrigate its surface freely for fifteen minutes with 3 per cent creolin, or 3 per cent lysol, or 5 per cent carbolic acid in water before applying the powder. Use the powder freely. In some cases it is advisable to make a second application of the powder fifteen minutes after the first.

If the suppuration is checked and the surface scabs over, then use the powder only. If free suppuration begins again, repeat the antiseptic irrigation, and powder as before.

Maggots. — This trouble can usually be prevented in small wounds by smearing the following mixture around the border: turpentine 1 part, tar 3 parts, fish oil 2 parts. If a wound becomes infested with maggots, use chloroform. This may be applied either by spraying or by throwing it in small drops from a sponge.

Suggestions. — Wounds frequently heal more rapidly and perfectly in open air than in the stable, because there is more ammonia in the air of the stable, and injurious germs are more abundant. Healing of some wounds is retarded by exercise, and such patients should be kept in the stable.

Rest from motion for the injured parts is generally favorable for wound healing.

In dressing a recent wound all dirt and foreign material, and usually all clots of blood, should be carefully removed. This may be done with a mild antiseptic solution used warm; *e.g.* 3 per cent carbolic acid or 3 per cent lysol. Ordinary cotton, preferably surgeon's cotton, will do very

nicely, but there should be as little rubbing as possible. It is frequently better to use a syringe than sponge or cotton.

The healing wound. — Healing wounds vary greatly in appearance. The wound that is called "healthy" or that is doing well has been described under Healing by Granulation. Wounds that are "unhealthy" or not doing well may be either pale, or dark with considerable heat, or show large soft granulations (proud flesh). When repair has apparently ceased and there is no progress toward healing, we say the wound is indolent.

For indolent wounds a good blister will frequently start active healing. The so-called proud flesh or bad granulation may be removed from "unhealthy" wounds by the knife or actual cautery. Inflamed wounds should be treated with long-continued applications of warm water, or warm antiseptic poultices.

Punctured wounds are especially dangerous on account of tetanus and deep formation of pus with absorption of septic poison. These deep wounds may be treated with hydrogen peroxide or carbolic acid deeply injected. In some cases they may be opened freely and exposed to air, which greatly reduces the danger.

LECTURE XVIII

CAUSES AND PREVENTION OF DISEASE

CONTAGIUM

Definition. — Living germs which constitute the specific and primary cause of certain diseases and which may be transmitted from one animal to another. An outbreak of disease may be *enzoötic* (local), or *epizoötic* (widely spread).

Description. — Bacteria are vegetable microörganisms. Each individual consists of a single cell. They are of almost infinite number of species and varieties, and are present in the atmosphere in particles of room dust, in drinking water, in the soil, and, in fact, almost everywhere in great abundance.

Size. — They are extremely small, requiring the highest powers of the microscope to make them distinctly visible. It is estimated that millions may live comfortably in a single drop of fluid. An average bacillus is from $\frac{1}{25000}$ to $\frac{2}{25000}$ of an inch long.

Motion. — Some of these little plants have positive motility, others have no true motility; many of them have a peculiar dancing motion (Brownian motion).

Nutrition. — Bacteria use for their food the chemical elements, oxygen, nitrogen, carbon, hydrogen, phosphorus, and sulphur. Like higher beings, they vary in their likes and dislikes. What is wholesome for one may be very injurious to another. Each species has its certain conditions of moisture, temperature, and chemical reaction which are most favorable.

Reproduction. — These little beings reproduce by fission and by spore formation. If the fission is incomplete, they

remain in chains. The spore is the hardy resistant form and corresponds imperfectly to seed formation of higher plants. It is estimated that one individual may increase to 1,176,570 in 10 hours.

Plagues in history. — Throughout all the pages of history, we have records of fearful plagues among men and animals. About 1500 years before Christ a great plague of murrain swept through Egypt and made a great slaughter of cattle. We are told concerning the plague at Athens, 430 B.C., that dead men, dead animals, and dead birds lay in piles on the streets, and even the temple floors were covered with bodies.

Plagues recur at intervals through the history of the city of Rome. About 453 B.C. an outbreak, possibly anthrax, destroyed nearly one half the population of Rome, as well as their cattle, and the outbreak spread extensively through what is now Italy. A widespread outbreak of anthrax occurred in France and Belgium, 591 A.D. This same disease is said to have spread all over Europe again about 1750. Cattle plague was carried into England in 1745, and the loss was very heavy. This outbreak lasted for several years in various parts of Europe, and the loss cannot be estimated. Tuberculosis has long been prevalent. These are all contagious diseases and are caused by bacteria. The above are but isolated examples of an indefinite number of outbreaks of various diseases which have appeared among domestic animals.

How scattered. — Germs of diseases are scattered by a very great many agencies; for instance, the germs of hog cholera are disseminated by means of the diseased carcasses, hog racks, stock cars, and they may be easily transferred by the shoes or clothing of persons who walk through an infected yard. Dogs undoubtedly serve to scatter this disease over wide areas, and possibly birds. It is possible, also, for the germs to be scattered upon particles of dust and litter in high winds. Watering troughs, tanks, ponds, and sluggish streams are all common sources for spreading infectious diseases.

Development of outbreaks. — It seems to be true of several, and possibly so of a great many, diseases, that the germs may be present with the animal or his surroundings but not virulent enough to produce disease. Under favorable conditions and perhaps after passing through the bodies of several susceptible animals in succession they may increase in virulence sufficiently to produce disease.

Some of the germs producing diseases of domestic animals are believed to live for very long periods of time and even vegetate outside the animal body, possibly upon or within the tissues of plants. Some germs, especially in the resisting or spore stage, may live for very long periods of time, and under very unfavorable conditions retain virulence; for example, the spores of anthrax.

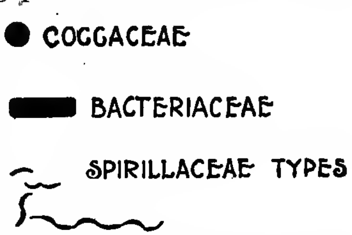

FIG. 32.—GENERAL GROUPS OF BACTERIA. DIAGRAMMATIC. (*M.H.R.*)

Some outbreaks of infectious diseases appear very suddenly, with the most virulent and rapidly fatal cases appearing earliest in the outbreak. The outbreak then gradually loses virulence, the last cases being of a decidedly chronic nature, and some of them possibly recovering. This is frequently illustrated in hog cholera. It is possible, however, that, before the virulent form was noticed, there may have been a series of very mild cases, the animals not being appreciably sick; but the germs in passing through susceptible bodies greatly increased in virulence until they were able to produce a rapidly fatal type of the disease.

Body entrance. — Germs gain entrance through the respiratory organs with the inspired air; through the digestive organs, through cuts or scratches in the skin and mucous membranes; and rarely infection occurs before birth.

Method of injury. — Germs cause injury and disease in at least two different ways: *First*, by rapid multiplication and mechanical presence in inconceivable numbers. As an example of disease caused by germs in this way, at least partly

by mechanical presence, we have actinomycosis (lumpy jaw). *Second*, germs which by chemical action may produce intensely poisonous substances in the blood and body tissues. As an example of this we have tetanus and diphtheria.

How disposed of in nature. — Nature disposes of disease germs in a variety of ways, principally by oxidation, by the devitalizing effect of sunlight, and they are scattered over wide areas and enormously diluted by the wind and water.

Classification. — Germs are classified into general families according to form, multiplication, presence or absence of sheath, and whether motile or not. There are at least three general family types of bacteria: —

First, *Coccaceæ*. — These are spherical. A great many of the most common diseases are caused by germs which belong to this general family. For instance, erysipelas and various types of blood poisoning, abscesses, and sloughing.

Second, *Bacteriaceæ*. — These are short, rod-shaped germs. Among the common diseases of live stock which are caused by germs belonging to this general family, there may be given as illustrations, tuberculosis, glanders, tetanus (lock-jaw), and hemorrhagic septicæmia.

Third, *Spirillaceæ*. — The individuals are rod-shaped, curved, or spiral and may be very short or very long. The specific cause of Asiatic fever (human) belongs in this general group.

Practical suggestions. — The student should bear clearly in mind that bacteria or germs usually require very favorable conditions for existence, and especially for retaining disease-producing power. Make conditions unfavorable for them by vigorous health, by high resisting power on the part of the animal, and by sunshine and ventilation.

Bear in mind that germs are actual substances, tiny particles of living matter, and may be carried about in any way that very fine particles of dust may be scattered.

The beginning of an outbreak may come in two ways: *first*, by recent introduction of germs, *e.g.* anthrax in north-

ern states. Or, *second,* an outbreak of infectious disease may be caused by increased virulence in case of germs already present, but not previously capable of producing disease. This increase of virulence may be due to surrounding conditions especially favorable to germ life. This probably occurs, *e.g.* in diphtheria and pneumonia.

Apparently it makes great difference in many diseases as to the number of germs taken into the body, — hence the necessity of sunshine to reduce virulence and destroy germs and of ventilation to carry as many of them as possible out into the open air.

Bearing in mind now what has been said of germs, it is easy to see how glanders with infection left in feed boxes or water pails may be spread from horse to horse; how hog cholera with infection, especially in the manure, may be easily and rapidly spread; or how lumpy jaw may be spread with its germs in the pus scattered from abscesses.

LECTURE XIX

CAUSES AND PREVENTION OF DISEASE

DISINFECTION

Purpose. — In veterinary practice, disinfection is intended to check the spread of infectious diseases, and to protect from further infection animals which may be already diseased.

Sources of infection. — In any process of disinfection it is important to know something concerning the nature of the infecting germ, and the sources from which it comes. Germs of diseases are spread in a great variety of ways; for instance, with the body fluids of sick animals, by soiled water or food, or by any contaminated matter. Air may be contaminated from the skin and lungs of diseased animals. The soil may be contaminated by the burial of diseased animals or by the deposit of any infectious material upon the surface. In any such case, germs may be washed to ponds, sluggish streams, or shallow wells, thus contaminating the water. Hides, offal, and even the hair of a diseased animal may be a source of spreading disease.

Must be thorough. — Disinfection is not reliable and should not be depended upon unless done most thoroughly. A small yard may be disinfected by having straw burned over it, or the earth may be removed to a depth of at least six inches and replaced with fresh earth. Paved flooring may be disinfected by burning over it any inflammable material. Cracks should be disinfected by free use of corrosive sublimate solution. Food which may have been contaminated should ordinarily be destroyed, but in some cases such food may be given to nonsusceptible animals. Drinking

places should be disinfected, also currycombs, brushes, and everything of that sort.

Attendants. — Attendants for sick animals should be very careful about their clothing, particularly trousers and shoes. It is well to use special overalls and overshoes, which should be left at the infected stall or building.

Dogs, rats, and any of the smaller animals which are liable to convey the disease should be guarded against.

"**How to burn a carcass.**"* — Dig a cross-shaped trench about 12 inches deep in the center, becoming shallow toward the edges; about seven feet long each way. The earth is thrown in the angles; two bars of iron are placed across for a bridge, and upon them the fuel is placed. The trunk of the carcass is placed upon the fuel, then another layer of fuel, then the internal organs and limbs of the carcass, and finally another layer of wood. The cross-shaped trench gives a draft — no matter which way the wind may be blowing.

DISINFECTANTS

Alcohol. — This is considered unreliable, not strong enough in its germ-destroying properties, but useful for certain purposes, particularly as an aid in disinfecting greasy surfaces.

Carbolic acid. — Pure carbolic acid is usually seen in the form of light-colored crystals, sometimes slightly red. As sold in the drug stores it is usually liquefied by the addition of 5 to 8 per cent of water. It is soluble in water up to about 6 per cent. This is one of the most commonly used and most reliable disinfectants. It is objectionable in being quite poisonous; but it does not destroy clothing or corrode metals like corrosive sublimate. The best antidote is probably alcohol for internal poisoning or for external burns. Alcohol may be given in large doses for this purpose. For disinfection, use a 5 per cent solution.

Crude carbolic acid was formerly a very valuable disin-

* Method recommended by Dr. F. Smith.

fectant, and cheap, but it has fallen into discredit because some of that put on the market in later years has been robbed of its disinfecting properties in the manufacture of various proprietary disinfectants.

Creolin. — This is supposed to be a combination of crude carbolic acid with soap. It is a dark brown, rather thick liquid, and makes a milky emulsion with water, used in 5 per cent solution.

Formalin. — A very important disinfectant, either as a liquid or when vaporized. It is in the market as a 40 per cent solution of formaldehyde gas. The odor is very irritating and disagreeable, resembling somewhat chlorine. Formalin is apparently more active in the presence of moisture. For use in vapor form, at least 20 ounces per 1000 cubic feet should be introduced rapidly into a tight room. Glycerine or borax should be added in the retort.

Formalin may be vaporized very satisfactorily by permanganate of potash in powder or fine crystals. Use 8 ounces of permanganate and 20 ounces formalin for each 1000 cubic feet of air when the inside temperature is 60 degrees F. or above. Use one fourth to one half more of the disinfectants for lower temperatures. A large flaring tin pail is used for each such mixture, and the permanganate should be put in first.

Fire. — The most reliable disinfectant, and the one that should be invariably used where an article may be destroyed.

Moist heat. — More active and reliable than dry heat at same temperature. Boiling for an hour is probably sufficient to destroy any known disease-producing germs.

Corrosive sublimate. — This is sold in the form of white crystals or powder. It dissolves in about 16 parts of water, and its solubility can be increased by muratic acid or iodide of potash. It is disinfectant in the proportion of 1 to 2000, about $3\frac{1}{2}$ grains to a pint of water, and in even more dilute solution. A convenient solution can be made by dissolving it in alcohol, 1 to 8, then a teaspoonful of this to a quart of water gives a 1 to 2000 solution. Corrosive sublimate is

dangerously poisonous; it coagulates albumin, and corrodes and destroys metals.

Sulphur is probably not as efficient as is generally supposed. If a very large quantity of sulphur is used, after the surfaces to be disinfected have been moistened by steam or otherwise and doors and windows kept tightly closed for a long period of time, then it seems to have decided germ-destroying properties. There is needed about 10 pounds per 1000 cubic feet of air. This may be easily burned by the addition of about three or four ounces of alcohol, the whole being placed in an iron kettle, and that in a tub of boiling water, partly for safety and partly for moisture.

Sunshine. — Destroys germs. Whenever sufficient time may be had, infected clothing or any article to be disinfected, especially where the infection is on the surface, can be rendered safe by long exposure to sunshine.

LECTURE XX

CAUSES AND PREVENTION OF DISEASE

HEREDITY

Definition. — The great law of inheritance that "like tends to produce like." This tendency may apply to any peculiarity. Heredity may appear as a factor in the cause of disease when actual disease germs are transmitted, which is rare, or when a local weakness or general susceptibility appears, which is favorable to the development of disease. Statistics are meager, but essential facts are very plain as to the relation of heredity to many diseases.

Theory. — The modern idea of heredity in relation to disease is that the thing actually inherited is usually only a tendency or a lessened resistance. This may refer to the white corpuscles and serum of the blood as well as to the muscle and tendon or bone cells. This theory of lessened resistance applies to such conditions as spavins, ringbones, sidebones, roaring, and internal diseases alike. Under favorable conditions the actual development of disease may not occur. A stallion with certain defects of the eyes is apt to sire colts with bad eyes. Mares with curby or spavined hocks are equally apt to raise colts with bad hocks. In rare cases the young is born with the actual disease present.

In-and-in breeding. — This tends in some cases toward decrease of physical vigor, infertility, tendency to abortion, and various other diseases, especially when long continued and with unwise mating.

AIR

Air is a very frequent source of disease. Its composition in a general way is: oxygen 1–5, nitrogen, 4–5; more accu-

rately, oxygen 20.97 per cent, nitrogen 79 per cent, and carbon dioxide gas (CO_2) .03 per cent.

Impurities in air are taken care of by nature through diffusion, oxidation, sunlight, and plant life activity. Common impurities in air are carbonic gas, ammonia, germs of very many different kinds; scales and débris of epithelium, hair, sputum, dried manure, dried pus, and various matters from sewer pipes and marshy grounds.

Relation to disease. — Diseases related to impure air are many and serious; *e.g.* total mortality among French cavalry horses was formerly as high as 18 to 20 per cent, but was reduced by ventilation and better sanitary conditions to 7 per cent. Farcy in the English cavalry used to be exceedingly common, but is now rare. In 1857 there was a serious outbreak of influenza that could not be checked until certain stables were cleaned and ventilated.

Horses' lungs have about 289 square feet of air-absorbing surface or five times the skin area. They may contain at one time 1.5 feet of air. Horses at rest may give off 6.5 to 7.5 cubic feet of CO_2 every hour.

Air begins to get foul when oxygen is reduced to 20.6 per cent, or taking another means of estimating, air generally begins to be foul when CO_2 goes above .05 per cent; but is not necessarily very harmful.

Carbon dioxide (CO_2) is not poisonous in small quantities of itself, but significant because of the poisonous inorganic impurities with which it may be associated. Common statements that CO_2 at 1 per cent is very poisonous or fatal are nonsense. See Minn. Exp. Sta. Bulletin 98. When present in very great excess, it supplants oxygen in blood, causes paralysis of heart, and overwork, then failure, of the lungs.

Hydrogen sulphide may also be present in the air. Four tenths (.4 per cent) per cent is said to be fatal to horses, causing diarrhea and extreme weakness.

Nitrogen is nearly negative in effect. It dilutes oxygen and CO_2.

Ammonia in air must also be regarded as an impurity so far as animal life is concerned, mainly because of the organic matters with which it associates.

Practical application. — A very practical lesson and a very obvious one is to breed from sound and vigorous stock. Farmers do unwisely when they patronize unsound and inferior sires, simply because the cost of service is low. The Minnesota Stallion Law specifies the following diseases as bars for registration on the ground that the diseases are transmissible either directly or indirectly by heredity: cataract, amaurosis, laryngeal hemiplegia (roaring or whistling), chorea (St. Vitus' dance, crampiness, shivering, springhalt), bone spavin, ringbone, sidebone, and curb when accompanied by curby hock.

Farmers should not patronize stallions affected with any of these conditions, nor should they be misled into purchasing such stallions. The present outlook is that such stallions will be barred from public service in a large number of states within a few years. It should be borne in mind that a fat animal is not necessarily sound or healthy. Domestic animals may be and frequently are in show condition and yet badly diseased.

The spread of tuberculosis in a stable is a good illustration of transmission of disease due to bad air conditions. With an infectious case of tuberculosis already in the herd, tuberculosis spreads much more rapidly in unventilated stables than in well-ventilated stables.

Ventilation, therefore, is very important and should be thorough. It accomplishes two purposes: admits oxygen, dilutes and removes impurities. Good ventilation implies rapid change in air without direct draughts upon confined animals. Each mature cow or horse should have about 35 square feet of floor space and at least 1000 cubic feet of air — better 1500, and this should be renewed frequently (see Lecture on Ventilation).

Sunshine is equally important, for sunshine is nature's universal disinfectant, killing more or less rapidly germs of disease.

LECTURE XXI

CAUSES AND PREVENTION OF DISEASES

VENTILATION

Purposes. — There are two purposes in ventilation, viz. getting fresh air with its oxygen into a stable, and getting impurities out, and these are equally important.

Impurities. — The common impurities of air are disease germs and their products; carbon dioxide gas, various volatile matters from the lungs, together with the various excretions and the products which result from their chemical decompositions.

Stable air. — One good authority (F. Smith) reports an analyses of air for European stables. The average of 28 analysis gave .14 per cent carbonic gas (CO_2). In another series of 28 analyses he found an average of .21 per cent. A French authority found .7 per cent CO_2 in a military stable. For a normal outside air we may take about .03 per cent CO_2.

In some of our own work (Reynolds and Lipp) with a steer closely confined in an especially prepared tight stall we obtained the following record of CO' percentages after varying periods of confinement and with very accurate work. After 6 hours, .94 per cent; after 12 hours, .71 per cent; average after two 24-hour periods, 1.03 per cent; after 48 hours, .68 per cent. The animal was a young steer weighing about 500 pounds, and was confined in a stall containing 784 cubic feet of air.

Another steer 200 pounds heavier in the same series of experiments gave for an average of three 24-hour periods, 1.09 per cent; at 42 hours, .98 per cent. It may be inter-

esting for the student to note the decrease of CO_2 rather than an increase, which would usually be expected. This occurred many times in our experimental work and is quite easily explained on chemical grounds.

Necessity of ventilation. — To illustrate the effect of poor sanitary conditions, particularly lack of ventilation, it is only necessary to call attention to the common experience of moving an animal affected with a chronic type of glanders or tuberculosis from a well-lighted and well-ventilated stable to one where the conditions are the opposite. Under the latter conditions there is rapid development of a disease which had been mild.

Sick animals especially need free ventilation. This is particularly true in certain diseases, *e.g.* tetanus and diseases of the lungs.

A moderately warm barn in a cold climate is not objectionable, providing sanitary conditions, such as abundant air, sunlight, good food, and water, are provided. But making a barn warm and tight may very easily establish an ideal place for the propagation of germs and the spread of disease.

Carbonic gas (CO_2) can no longer be considered a reliable index of an atmosphere's injurious quality. In fact our work has shown it to be a very unreliable guide in this respect. But it is a very convenient guide as to ventilation accomplished.

Unventilated stable air. — Writers and teachers on the subject of hygiene are agreed that unventilated air is harmful. The student may safely take their statements as correct in a general way, but may just as safely doubt the usual explanation.

Work done at the Minnesota Experiment Station seems to demonstrate quite conclusively that the accepted explanations are incorrect; that any probable increase of CO_2 or any probable decrease of oxygen are not especially important. This work seems to show that the injury comes from entirely different factors.

The Minnesota Station has had a number of different animals continue apparently in good health when confined for very considerable periods in very high percentages of CO_2. In one case a steer made good gains, was bright and active, and showed no important physiological disturbances when confined in air containing CO_2, ranging as high as 2.67 per cent, or nearly 90 times the average for outside air.

Experimental work shows that decrease of oxygen does not lessen the amount absorbed by the animal until we reach the very low level of about 13 per cent, 20.97 per cent being taken as a normal. But 13 volumes per cent is much lower than would be found in any stable.

Excretion of CO_2 may be checked and difficult respiration occur in case of very great excess of this gas. It has been found by other experimenters that when the air contains from 3 to 4 volumes per cent of CO_2 the excretion of gas may be checked 50 per cent, but without harmful effect that could be detected. The excretion of CO_2 is practically independent of percentage of oxygen in the air. One very good authority (Landois) tells us that tissue metabolism is not disturbed by variation of oxygen within a range between 10.5 to 87 per cent. Below 10.5 percentage of oxygen there were marked physiological disturbances, but this is far below any probable stable percentage.

There does not appear any good reason for doubting the importance of stable ventilation. It is equally plain, however, that the injurious effects of unventilated air in common stables does not come from high CO_2 or low oxygen percentages, and that we must seek the explanation in other directions. Accumulation of harmful germs may give a portion of the explanation.

Natural forces. — *The factors that operate in natural ventilation are:* —

First. The force of the wind.

Second. Weight of air, as varied by its temperature.

Third. Diffusion of gases in obedience to a natural law.

Wind. — The force of the wind is probably the most im-

portant one of these factors, and must always be taken into consideration in planning ventilation or in mathematical estimates of the amount of air needed. It is, of course, irregular, but variations can be made in the ventilating facilities to compensate for this. A fundamental point

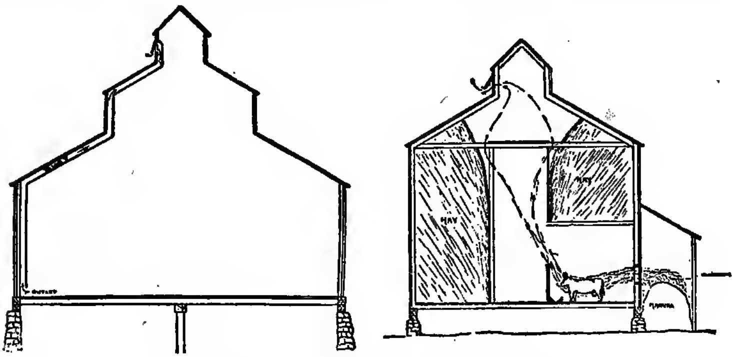

FIG. 33. — VENTILATION. (*Paige.*)

Outlet with too many angles. Cow receiving inlet air from over a manure pile.

in using this factor is to see that the incoming air does not pass over or through any contaminating source, *e.g.* over a manure pile, and it is very important that the general plan of construction should be well considered.

Temperature and weight. — The second factor, difference in weight between the lighter warm and heavier cold air, is not so important in natural as in artificial ventilation, and yet it is a factor of considerable importance. The heat which warms the air in the lower levels is that which comes from the bodies of the confined animals, as it is radiated from the surface or warmed in passing through the lungs.

Diffusion of gases. — Carbonic gas is considerably heavier than air, and the lower levels usually contain a slightly higher percentage than the higher ones in a stable, but the difference is not so great as one would suppose, on account of the diffusion which takes place in response to the law of diffusion of gases — which operates independently of

relative weights. This force is so strong in its action that some diffusion takes place through unpainted lumber and through ordinary brick, but to a very slight extent if at all through painted surfaces or paper.

AIR CURRENTS

An entering current of air has the effect of inducing other currents within the stable, the induced current setting in at right angles to the inlet current.

With windows wide open to windward, openings on the

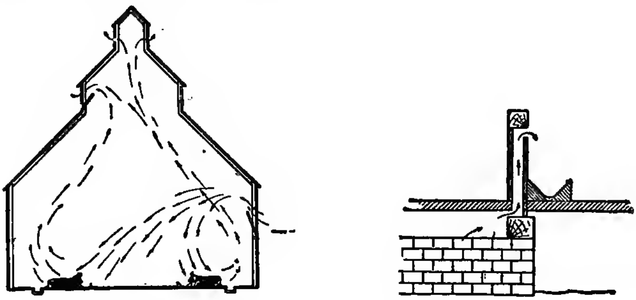

Fig. 34.—Ventilation. (*Paige.*)

Air Currents. Manger front inlet.

other side of the stable being closed, and with ridge ventilation, it is found* that the current of air rushes in, strikes the floor at a variable distance after spreading out somewhat, then rises and most of it passes out at the ridge. A current decreases very rapidly in velocity after the first five or six feet from the inlet. The atmosphere immediately under the inlet is but moderately disturbed.

When opposite windows are open, the air comes in from the windward side, strikes the ground, rises again, and a considerable portion passes directly out at the opposite side. But a sudden change in the outside currents may temporarily reverse this series.

With the windward window half open, the window on

* Paige

the lee side being open, the current passes directly through the stable without mixing well with the air inside.

When the windows are all closed, and a door open, then the ridge gives a fairly regular outlet ventilation. The exact movement of the air within the stable would be varied, of course, by stall partitions and other obstructions.

A strong wind passing over a stable provided with ventilating shaft may have an outward suction effect, especially if some provision is made to insure this result. This may be accomplished by putting a flange around the upper opening so as to direct the outside current of air upward as it strikes the end of the outlet shaft.

Outlets. — In cases where suitable outlets are provided above, and the conditions are favorable, warmed air passes upward and out of the room or building; but if such outlets are not provided, then of course the heated air merely rises to the ceiling, cools, spreads out and descends, and no pure air can come in to take its place. If the outlets are too high, the effects are practically the same as though there were no outlets at all, for the air becomes cool before it escapes, and falls again.

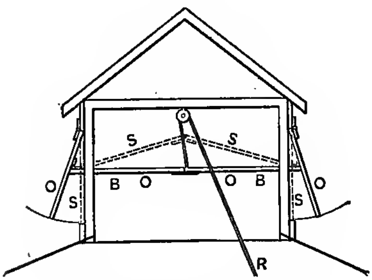

FIG. 35. — CUPOLA VENTILATION.

Wing describes a form of cupola ventilation which has been found quite satisfactory in providing air outlet for some barns (see Fig. 35). This cupola outlet seems always in operation. There is no chance for wind to blow in and force strong down drafts. When in working order, it serves always as an outlet. It is easily closed by a rope from the ground floor.

This cupola ventilator consists of a common cupola with doors on two opposite sides hinged above.

Connected with these doors, *S*, *O*, is a light board *B*, cut

in the middle and hinged. When this board is straight, it holds one or both doors partly open. If the wind blows against one side, that door closes and the lee side window opens. To close both doors pull down on the rope *R*.

Amount of ventilation needed. — The horse passes 45 cubic feet of air through the lungs per hour. This, then, would be the amount which the average horse would use if he were out in the open where the supply is inexhaustible. It is impossible to have the air of any occupied stable as pure as the outside atmosphere. The purpose of ventilation is to come as near to this point as may be feasible.

It has been estimated that the air should not be changed more than six times per hour in cool weather, on account of drafts which more frequent change would produce, and the loss of animal heat.

Air passing at the rate of 3 miles per hour, which is barely perceptible, through an opening 1 foot square, admits 15,840 cubic feet per hour. A shaft 2 feet square admitting a current of air moving at the average rate of 3 miles per hour is estimated to provide sufficient ventilation for 20 cows.

LECTURE XXII

CAUSES AND PREVENTION OF DISEASES

VENTILATION — *Continued*

Stable Construction

Space needed. — A large cubic space per animal is important, but this does not lessen the necessity for ventilation. The atmosphere in a large stable with a given number of animals may become just as foul as a smaller stable with the same number of animals, the only difference being in the length of time required to reach this condition. The chief value in a large amount of space is that it gives the possibility of admitting a sufficient amount of air without such severe drafts as would necessarily be the result of admitting the same amount of air per hour into a smaller stable.

Location. — In order that a stable may be well lighted and well ventilated it is necessary to have considerable care in selecting the location and planning the proportions of the building. One of the most desirable forms is that of a main part standing east and west and used in a general way for storing purposes, with one or two " ells " at right angles to this on the south. This arrangement makes possible a very satisfactory and well-protected yard on the south side, and gives an even lighting to the various portions of the " ells " in which the animals are kept. It will be readily seen that when a stable extends east and west, and is wide enough for two rows of stalls, the animals on the north side do not get much light, for the general lighting of their portion of the stable is poor.

Width. — A stable to be capable of the best ventilation should not be over 25 to 30 feet in width; and the lower the better within limits, when one is depending on natural conditions.

Windows. — In order to secure suitable ventilation in a building of this kind two sets of windows should be provided, at least one set on each side; and better, two sets on each side. Doors and windows should be opposite, *i.e.* door opposite door and window opposite window wherever practicable.

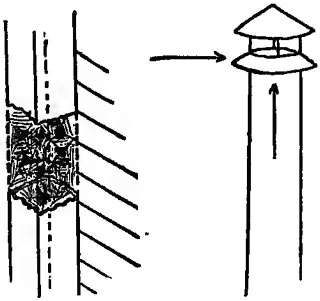

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FIG. 36. — VENTILATION. (*Paige.*)

1. Air duct obstructed by cobwebs and dust.
2. Stationary outlet cowl to utilize the force of the wind for producing upward suction, and to prevent down draft.

It can be stated in a general way that where one is depending upon natural ventilation, and the air is brought in cold, the inlet should be low and the outlet high; but this does not imply that the stable need be very high.

Shafts and tubes. — In considering ventilation by shafts and tubes, it should be remembered that circular, straight tubes are preferable, and as for outlets, the shorter the better. It is estimated that a right-angle bend in an outlet diminishes the velocity of the outgoing air about one half. Where it is absolutely necessary that an outlet tube should change its course, it should be done in a curve or slight bend rather than by a right-angle bend. All parts of such shafts and tubes should be accessible for cleaning purposes, as it is no uncommon thing for them to become obstructed by cobwebs and dust so as to be practically useless. In a general way the outlet tube, if near an outside wall, should be placed on the south side of the building, so as to economize the heat of the sun in rendering it more effective. Central outlet tubes are generally more efficient, because they cool less the column of air.

Several small inlets are always better than one or two

large ones, as they admit the same volume of air, and give it better distribution, without direct currents.

Sheringham valve. — The Sheringham valve is simple and efficient for a stable of suitable construction. This system consists essentially of windows hinged at the bottom and guarded at the sides so as to make troughs as the windows open inward. This gives the air an upward current, passing over the backs of the animals and settling down without direct current. There should preferably be two sets of windows on each side, the lower windows being generally used for inlets on the windward side, and the higher windows for the outlets on the leeward side. This affords a very simple, inexpensive, and easily manipulated method of ventilation, and may be combined with ventilating shafts. Outlet ventilating shafts should have openings near the ceiling, and also close to the floor, so that their use can be regulated according to season and temperature. The upper openings of the shaft being used in hot weather, and the lower openings in cold weather.

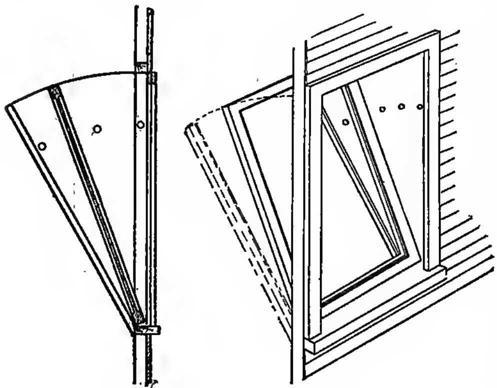

FIG. 37. — VENTILATION. (*Paige.*)

1. Sheringham window in section.
2. Sheringham window, opening inward. Seen from outside.

There should be a number of medium-sized or even small windows in this system rather than a few large ones. The same amount of air can be allowed to enter through the small openings without direct draft, and with much better distribution.

LECTURE XXIII

CAUSES AND PREVENTION OF DISEASES

FOOD

Food may be a factor in animal disease when excessive in amount, insufficient, too concentrated, too coarse, bulky, and innutritious for the animal that receives it; poor in quality; when given in a poorly balanced ration or at irregular or improper intervals; when given a very tired or hot animal; when carrying vegetable or animal parasites; or when suddenly changed, *e.g.* poor to rich pasture; and when poisonous.

Excessive amount. — Common tendency to overfeed results in azoturia, heaves, colic, etc., among horses; milk fever, etc., among cows, and favors the development of all febrile diseases. Only a certain amount can be absorbed or used; the remainder causes trouble.

Deficiency predisposes to all diseases that are favored by a lessened vitality. Glanders and similar diseases are especially apt to occur or to increase in severity among horses that are poorly fed. Deficiency in food mineral matters predisposes toward certain diseases of bone. Deficiency of albumin results in loss of energy and strength, and animals so fed are apt to be languid and weak.

Coarse, bulky, and innutritious food may cause colic, indigestion, heaves, and impactions; especially apt to cause trouble with animals with small stomachs, *e.g.* horse.

Poor quality, e.g. hay cut too ripe or rained on after cut, light oats, etc. Objections same as deficiency, also favors colic, impactions, and anæmia.

A food may be *poorly balanced* and dangerous though very

nutritious; *e.g.* beans, wheat, oil meal, and cotton-seed meal contain alone too much protein and not enough ash, fat, and carbohydrates. When fed in the unbalanced ration, such excess of protein may cause febrile disturbances, diarrhea, congestion of the liver, azoturia, and milk fever. A similar excess of carbohydrates or fats may cause an injurious deposition of fat under the skin; into and between the fibers of voluntary muscles, or in the heart and liver. Excess of fats causes diarrhea and checks absorption.

Faulty intervals interfere with digestion and thrift, and may cause such disorders as colic and impaction. Cows may be fed at longer intervals than horses; but both should be fed regularly. A horse that goes a long time without food and then gets abundance is apt to have colic.

Vegetable parasites, like bunt, smut, rust, ergot, and mildew, may cause abortions, diabetes, anæmia, and putrid sore throat.

Animal parasites infest several foods; lessen their food value and cause skin troubles.

Sudden changes, from poor to rich pastures, favor anthrax, hoven, impaction, and black leg.

Class differences. — Some animals may eat with impunity what others cannot. Rich cereals may indirectly cause laminitis in horse, — not in cow. Pigs can eat acorns freely, but they are injurious to other animals.

WATER

Water may be a factor in animal disease when excessive in amount or deficient; when containing low forms of vegetable life; when containing low forms of animal life; when it has received sewage matter; when very hard, *e.g.* containing much calcium and magnesium salts; when given at improper intervals or soon after eating, or when given in large quantities to a very hot or tired horse.

Excessive amount of water lessens the digestibility of

foods, causes an increased tissue waste, and favors indigestion.

Deficient water supply may cause impactions in cattle and lessen the excretions from skin and kidneys in horses. Horses need about 2 pounds and cows giving milk about 4 pounds of water per pound of dry food; the amount varying according to diet and condition of the atmosphere. Cows need much more than horses in proportion to weight and feed, and can be usually trusted to drink at their own pleasure. Horses will frequently drink too much, especially when tired or hot.

Vegetable parasites frequently contaminate drinking water, and water may serve as a source of transmission for many germ diseases; *e.g.* anthrax, foot and mouth disease, hog cholera, and glanders.

Animal parasites often contaminate the water supply, which thus serve to spread parasitic diseases; *e.g.* intestinal parasites.

Sewage matter may get into drinking water from various sources and cause abortions and poison the system in many ways that may result in different diseases.

Hard water may contain much calcium, magnesium, etc., and cause indigestion, unthrifty conditions, and perhaps calculi.

Intervals may be wrong. Horses should be watered regularly and at as short intervals as convenient. They should not be given large quantities of water sooner than one hour after eating grain. Much cold water interferes with digestion, and when given to a very hot or tired horse may result in founder or indigestion.

Practical application. — With this lesson in mind the student should hereafter be on the watch for milk fever cases to see if the cow has not been in good condition and rather heavily fed for a cow not milking, and lacking in exercise.

He should be on the watch for azoturia (see page 207) and learn whether the horse has not been idle and full fed

during the day or so prior to illness. Note also whether before this idle period there had not been a period of regular work on full feed.

He should be on the watch for cases of heaves among horses and if such horses have not been greedy eaters and heavily fed with dusty hay or other bulky food.

Students should be on the lookout for putrid sore throat (infectious cerebro-spinal meningitis) in horses and see if such horses have not been eating some spoiled, *e.g.* moldy, corn.

It will be interesting for the student to be on the lookout for an outbreak of hog cholera in a herd that had access to a small pond or very sluggish stream and see if there is not unusually heavy losses in such cases.

LECTURE XXIV

CAUSES AND PREVENTION OF DISEASES

PARASITISM

Parasitism may be temporary or permanent, external or internal.

Parasites of domestic animals cause greater losses than is generally realized. Every stockman should be informed concerning the most common and serious parasites. He should be especially well informed concerning sheep parasites.

Temporary when only a portion of the parasite's life history is with one host.

Permanent when its whole life history is with the same host.

External or internal, i.e. affecting the body surface or affecting the internal organs.

General classes. — In studying diseases of domestic animals, we deal mainly with two general classes: worms and arthropodes.

Worms. — Invertebrates with soft contractile bodies, either composed of similar rings or nonarticulated; excretory organs in pairs opening externally. Members of this group affect many of the internal organs and superficial parts as well.

Arthropodes. — Invertebrates, limbs jointed, bodies composed of dissimilar rings. In this group also we find both external and internal parasites.

Sources and causes of parasitic diseases. — Parasites may be received into the digestive apparatus with food or drink; they may gain entrance through the respiratory tract,

through the broken skin, or there may be external infection by contact.

Predisposing causes. — Species of host; age of host; condition of host; season of year and climate. Most animal parasites are enormously prolific, but very many eggs and immature forms are destroyed. Others never reach their proper host. Female louse may become ancestor of 10,000 lice in eight weeks; female itch mite may be ancestor of 1,000,000 in three months, or a certain tapeworm will furnish 150,000,000 eggs in one year.

How nourished. — Parasites often live on the exudate or excretion which results from their presence. Some have mouth and digestive organs; *e.g.* roundworms of the intestines. Others receive their nourishment by surface absorption or osmosis; *e.g.* tapeworms.

Effect on health of host depends on the organ or organs invaded; the rapidity of multiplication; the amount of nutrition used by parasite, and amount of irritation caused.

Intestinal parasites cause trouble by obstruction; by irritating and abstracting blood from the mucous membrane; by mechanical irritation, and by using nutrition. Hence we have symptoms of indigestion, colic, and unthrift.

Liver parasites cause jaundice and general anæmia.

Lung and bronchial parasites cause bronchitis or pneumonia.

Parasites in the blood vessels cause disease of the vessel walls, and may indirectly cause obstructions and colic.

Parasites in the brain are more rare and usually fatal.

Parasites in muscular tissue may cause little disturbance to the animal host, but be very serious to human health; *e.g.* pig measles, trichina, actinomycosis (lumpy jaw).

General prevention. — Parasitism would be impossible if everything that comes in contact with the animal body were free from parasites. Saddles, harness, blankets, posts, and fences are the usual agents which spread Texas itch or mange among horses; round intestinal worms generally gain entrance in the egg or immature form, with the water drank.

Ponds, wells which receive surface drainage, sluggish streams and marshes, should therefore be regarded with suspicion. Sound animals should not be allowed in sheds, yards, or barns where animals diseased by external parasites, like lice or scab mites, have been, until such structures have been disinfected. Dogs are dangerous factors in sheep pastures, because of the tapeworms which they furnish to sheep. Intestinal worms which appear in the manure of horses should be destroyed with boiling water, — not merely crushed and thrown away.

General treatment. — Medical treatment must be such as will destroy or remove the parasites. Medicines may aid us in removing parasites by suffocating them, *e.g.* as with oils; or by poisoning the parasites; or by caustic or irritating chemical effect on the bodies of the parasites. Many parasites disappear by means of their own activity and habits; *e.g.* ticks, bots in horses, grubs in backs of cattle, and grubs in the nasal passages and head cavities of sheep. It is well to remember also that many parasites can resist stronger medicines than the organs or tissues they invade; *e.g.* bots in the horse's stomach.

EXTERNAL PARASITES

Most serious are the following: itch, mange, and sheep scab (due to mites), lice, ticks, flies, and ringworms.

Mite diseases (*acariasis*). — The various forms of itch or mange in horses, cattle, and hogs; scab in sheep; scabies in cats and dogs are all similar in cause, contagiousness, prevention, damage done, and in treatment. These diseases are caused by minute animal parasites. See Horse Mange, Lecture XXVI.

Causes. — Three types of mites, or acari, affect man and the lower animals, all very small: (*a*) sarcoptes, (*b*) psoroptes, (*c*) symbiotes. Each species of animal seems to have its own species of each of these varieties of mites.

The horse does not take mange from cattle or scab from sheep, and so it is with other animals.

Sarcoptes burrow channels and live in or beneath the skin. The eggs are laid and young hatched in these channels.

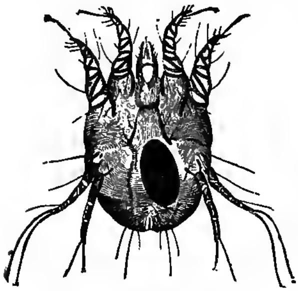

FIG. 38.—MANGE MITE.

The cause of one form of horse mange. *Psoroptes communis equi.*

Psoroptes live on skin surface. They can move around on the surface and spread rapidly.

Symbiotes affect regions near the feet and move about very little.

Diagnosis of mite disease is made on the condition of the skin, which becomes dry and wrinkled or leathery, with hairs partly gone; intense itching and the mites may be found among scales and roots of hairs, by standing the patient in the hot sun on the south side of a building, or by scraping off some of the diseased skin on a piece of black cloth and laying this in the hot sun. The mites may then be seen with a lens.

To find the sarcoptes, it is necessary to scrape deeply.

FIG. 39.—CATTLE LOUSE. FEMALE. *Haematopinus eurysternus.*

General treatment. — For mite diseases the treatment is essentially the same for all animals. Scrubbing brush, with soap and warm water, is a great help, and then some application to kill the mites. Sheep are dipped, larger animals are usually bathed. Shearing of sheep is almost necessary to satisfactory treatment. Clipping larger animals is quite an aid. Treatment must be thorough and directions followed. Sheep must go under, head and all. (See Mange and Sheep Scab, pages 112 and 119.)

General prevention of all forms of acariasis is merely the prevention of a skin infection. Generous feeding is a good

prevention for many of the parasitic diseases, because it does not allow animals like colts and calves to become thin and weak, and thus easy subjects for parasitic invasion. Tonics are frequently valuable to build up strength and increase the resisting powers.

DISEASES — PARASITIC

LECTURE XXV

SHEEP SCAB

Sheep scab is the result of irritation caused by little animal parasites as they burrow tunnels into the skin or puncture it from the surface. There are three types of these mites and three types of the disease which they cause. One variety of these mites produces body scab, another produces head scab, and a third produces foot scab. Body scab is by far the most common and most serious economically.

BODY SCAB

General history. — Body scab is caused by mites which have free power of movement (*Psoroptes*). This is the most common and serious type of sheep scab, because it spreads most rapidly over the individual body, and also spreads most rapidly through the flock.

This disease appears insidiously, and is liable to become quite serious before being noticed by the owner. The parasites which cause this type of the disease do not tunnel into the skin, but they cause intense irritation by reason of their presence and mode of life beneath the scabs. The owner will usually remember, after he has become aware that body scab exists in his flock, that his sheep have seemed uneasy and some of them have been rubbing and biting themselves occasionally for some time.

The parasites live beneath the crusts after the disease is well under way, and constantly migrate outward, while the skin slowly heals in the center. The fleece of scabby sheep

is usually rough, the wool is matted in places and easily rubbed off. The parasites which cause this form of the disease confine their work almost exclusively to parts of the body where the wool is long and thick.

How spread. — This form of the disease spreads rapidly through the flock; partly because of the location of parasites upon the body of the sheep, and partly because of the freely moving habits of the parasites. As a rule, the disease spreads more rapidly in autumn and winter, because the wool is then long and thick, furnishing favorable conditions for the parasites, and because the sheep are kept in closer contact at these seasons. The disease makes more rapid progress and is much more fatal with the weaker sheep. These parasites may be transferred from one sheep to another in a great variety of ways; for instance, tags of wool may be rubbed off and dropped almost anywhere. Diseased sheep infect posts and fences by rubbing against them, and the parasites escape from one sheep to another while the sheep are in close contact in yards and sheds.

These parasites may revive and become infectious after a short exposure to severe cold weather, but are soon destroyed by alternating changes of heat and cold. They may live three to four weeks, at ordinary temperatures and under ordinary conditions, around stables and sheds. Some authorities say they do not live longer than two or three weeks apart from the sheep's body, but it is certainly wise to extend this period to three or four weeks for safety.

FOOT SCAB

The disease caused by these mites (*Symbiotes*) appears on the feet and limbs. The diseased area extends very slowly, but may eventually reach the body. This form of scab spreads very slowly from one animal to another, and is therefore much less serious than body scab. Sheep having this disease are apt to be almost constantly stamping and pawing.

Local treatment. — Any of the sheep dips recommended for body scab are effective for this form of the disease. A 10 per cent solution of the creolin is simple, safe, and easily applied.

Any dip or ointment that will kill the parasites is sufficient early in the disease, but it may be necessary in old cases to soften the scabs by a little oil or a thorough scrubbing with brush and hot soapsuds. (See treatment.)

HEAD SCAB

The mites (*Sarcoptes*) which cause this type of the disease burrow tunnels in the skin. The eggs are deposited in these tunnels and there hatched. This type of the disease usually shows its first symptoms around the lips or nostrils, but may appear on almost any portion of the head. Occasionally it invades the neck and other portions of the body where the wool is short. This form of scab is much less common and less serious than body scab.

GENERAL PREVENTION

Prevention is more important than treatment in any case where it can be secured, because it is surer, it is cheaper, and is usually much easier to administer than medical treatment.

Spread of scab. — Whether the disease spreads rapidly over the body or not depends to some extent upon the thriftiness or unthriftiness of the individual animal. When sheep are fat and the wool is well supplied with yolk, this disease spreads slowly, and is much less serious. The infection is frequently made when one sheep rubs against posts or fences where scabby sheep have previously rubbed. In the latter case the mites are first transferred from the diseased sheep to the post, and then from the post to the healthy sheep. In other cases the mites are transferred when a diseased sheep rubs against a healthy one.

Exposure resistance. — The mites which cause foot scab

and body scab have considerable vitality, being able to withstand exposure at moderate temperatures from one to two or even three weeks under favorable conditions, possibly longer. They die sooner in a dry atmosphere than moist. Cases are on record where sheep seem to have become infected with scab in places where sheep had not been

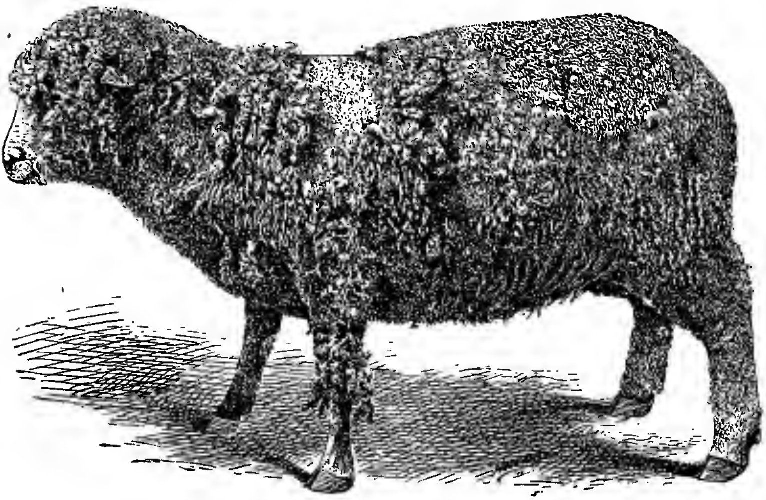

Fig. 40.—A Plain Case of Sheep Scab.

kept for many months. The history of these cases, however, is not well understood, and it is difficult to say positively how long mites or their eggs may preserve vitality under favorable conditions.

Precautions. — Scabby sheep should not be driven over any public highway. Pens, sheds, and yards which have held scabby sheep should be thoroughly cleaned and disinfected, and unless the disinfection is very thorough they should not be used for sheep until at least four weeks have elapsed. It is supposed that a hard rain will practically disinfect ground surfaces, but not fences and posts. Fields and pastures in which scabby sheep have been held should not be used again until after an interval of several weeks, and preferably not until after a heavy rain.

GENERAL SYMPTOMS

History and diagnosis. — At the point of first infection there appears a small, congested area, showing plainly the result of irritation caused by the parasite. Then there appears a little pimple, soft on top, which ruptures and a little fluid escapes. Dust and other foreign matter collect in this fluid and the initial scab is started.

Affected sheep are usually uneasy and are seen to scratch against posts, rub against other sheep, and even bite the itching surface. The irritation is most noticeable when the

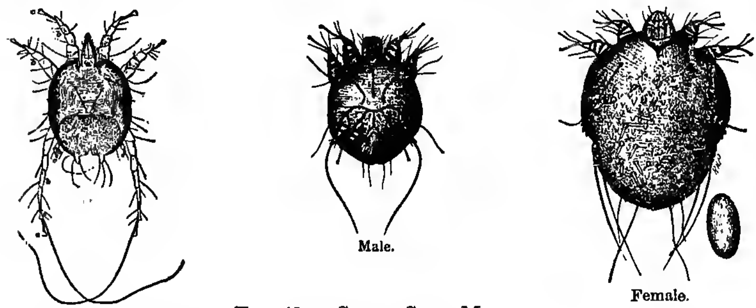

FIG. 41. — SHEEP SCAB MITES.

Psoroptes, male (*Curtice*). Body scab. | Sarcoptes (*Lugger*). Head scab. | Sarcoptes (*Pettit*). Head scab.

sheep are heated, as by exercise, or confined in a close room. At first the wool is noticed to hang in tags, the sheep begin to pull out portions of the wool with the mouth, and the skin becomes bare in small patches which gradually increase as the mites spread, irritating and inflaming the skin. To determine the presence of the mites, scrape off some of the scab and a little of the healthy skin near the border of the scab. Place these scrapings upon some smooth black surface in warm sunshine, and examine with a good hand lens. The mites may then be seen as minute white bodies. They are most certainly recognized when they are seen to move, and it is sometimes difficult to distinguish otherwise between the mites and particles of light-colored dust and epithelial scales from the skin surface. It should

be borne in mind when examining a case of head scab that the mites which cause this disease burrow beneath the surface of the skin, and it is necessary to scrape deeper than for ordinary body scab.

Possible mistakes. — It is well to bear in mind that certain other conditions may be mistaken for sheep scab, particularly disorders of the skin, produced by other external parasites; for instance, lice and sheep ticks. We have had in Minnesota an interesting outbreak of skin disease among sheep which on superficial examination resembled rather closely sheep scab, but was due to the awns of a certain wild grass (*Stipea sparta*), wild oats. It developed that these sheep had been pastured where this grass was abundant, and at a time when the awns were readily separated. These little spearlike bodies gradually worked their way through the wool into the skin, causing inflammation of the skin and considerable irritation.

TREATMENT

Suggestions. — Treatment is comparatively easy where there are but few sheep, but more difficult with large flocks. The size of the tank, material to be used, and method of dipping must depend upon the number of sheep, accessibility and expensiveness of different materials.

The dipping, as a rule, should be done after shearing, but it should be remembered that treatment for any parasitic disease of sheep should be given as early as practicable. Some good may be accomplished if the wool is parted by hand and care taken to get the medicine down to the skin, but it is the usual experience that dipping unshorn sheep is much less satisfactory.

The entire flock must be dipped; that is, those that are apparently well as well as those that are diseased. And the owner must bear in mind that, even after shearing, the wool may be a source of danger, and should be so kept and handled as to avoid the possibility of reinfection.

Dipping is effective only when it is thoroughly done. Tobacco, crude carbolic acid, arsenic, lime, and sulphur are the various ingredients that are commonly used in dipping for scab. The quantity of dip required per sheep varies from two to four gallons, according to the number of sheep dipped and the material used. Less dip is needed for shorn than unshorn sheep.

It is a good rule to use any dip at about 110 degrees F. and a good plan to rub the scabs with a stiff brush while the sheep are in the dip. Dipping should be repeated in 8 days, and in some cases it may be necessary to give even a third dipping after a second interval of 8 to 10 days.

For thorough work the entire flock should be shorn, then dipped and confined for 8 to 10 days in a place where there has been no scabby sheep for at least two months. At the close of this period of 8 to 10 days, the flock should be re-dipped and placed where there is no danger of infection. Sheep should be watered just before dipping.

Dips. — A great variety of dips have been recommended and successfully used. Several of the patent dips give excellent results, but these are usually more expensive than others and are objectionable, inasmuch as we do not know their composition. The following are perhaps as good as any: —

Lime-and-sulphur dip. — This is cheap and very effective for sheep scab. It has given good satisfaction when made and used according to directions.

Make this dip in the following proportions: ordinary sulphur 24 lbs.; unslaked lime 8 lbs.; water 100 gallons. The lime and sulphur are placed in a large kettle or other suitable container. Enough water is added to slake the lime and form a paste. After the lime is thoroughly slaked, add 30 gallons of water. The mixture is then boiled for 3 hours and allowed to settle overnight. The liquid should then be so drawn off as to avoid stirring up the sediment. A spigot placed about 4 inches from the bottom of the barrel or tank works nicely.

For use add enough water to make a total of 100 gallons. The ooze or sediment is not to be used on the animal body, but makes a good disinfectant for contaminated structures.

Lime and sulphur cannot be relied on to kill sheep ticks. Tobacco and sulphur or coal-tar dips should be used when there are both ticks and scab.

Coal-tar dips. — Dips of this class are now accepted by the Federal Bureau of Animal Industry when used in official strength. This strength is usually given on the package, and directions should be followed closely.

Texas dip. — What is known as the Texas dip is composed as follows: 30 lbs. tobacco, 7 lbs. sulphur, 3 lbs. concentrated lye, 100 gallons water. Allow the tobacco to soak in a portion of the water, which should be kept warm, for from 8 to 10 hours; then add the sulphur, remainder of the water, and concentrated lye, and boil for half an hour. Stir frequently while using.

Zundle's. — The following is a formula for a modification of Zundle's dip. (Modifications suggested by Dr. Kaiser.) For 100 sheep take the following: Tobacco, 13½ lbs. Soak for several hours in 66 gallons of water, then dissolve in this 8 lbs. of carbonate of soda and 4 lbs. freshly burned and slaked lime; then take 8 lbs. of softsoap and dilute with some of the hot tobacco infusion and add to the materials previously mixed; then add 4 lbs. crude carbolic acid; mix thoroughly. Use hot.

Dipping. — Each sheep should be kept in the dip at least two minutes by the watch, and each sheep to go under entirely at least once. Heavily pregnant ewes can be safely dipped if handled with care. In using any dip, no matter if proprietary or homemade, follow directions exactly. It is not uncommon for stockmen to have unsatisfactory results from the use of well-recognized dips, and it is usually because they try using the dip a little weaker than the directions call for, or because they were a little careless and hurried the sheep through the dipping vat too rapidly, or

by returning the sheep after dipping to infected pastures or yards.

Disinfection. — All structures that may have been contaminated should be cleaned and well disinfected unless sheep can be kept away from them for a long period, as previously indicated.

Any good dip should make also a good disinfectant for this use. In case a lime-and-sulphur dip is selected, then the "ooze" or sediment which would otherwise be discarded may be used.

LECTURE XXVI

HORSE MANGE

Causes. — Mange in horses is usually due to the irritation caused by a minute animal parasite, a mite, belonging to the group Arachnida. Specifically it is usually *Sarcoptes scabiei*, var. *equi*. This is one of the smaller mites practically invisible to the eye.

This particular species burrows tunnels into and under the skin. The eggs are laid and the young are hatched in these tunnels. On account of this tunneling habit, spread under the body surface is slow and the disease difficult to cure.

Symptoms. — The disease usually appears first on the head or side of the neck, and the first symptoms are small pimples and itching. The skin loses hair, becoming thickened, roughened, and perhaps wrinkled. Affected horses are much more uneasy at night, and particularly in a warm stable.

Treatment. — It is usually necessary to repeat treatment at least once and in bad cases several times at intervals of ten days. Treat all horses that have been exposed to infection, and watch closely for reappearance of the disease.

If the horses are halter broken, it is well to see that the scab is first removed by a thorough application of soft soap well rubbed in over the affected surface. The soap is left on for two or three hours and then washed off. The scab should then remove quite easily. Allow the skin to dry and apply one of the following treatments: —

(*a*) Creolin, or any of the cheaper coal-tar preparations, which are probably just as efficient, diluted with raw lin-

seed oil in the proportion of 1 to 16, and used for hand application and not as a plunge dip.

(*b*) The coal-tar preparations diluted with water in the official strength recognized by the Federal Bureau of Animal Industry (see directions on label).

(*c*) Experienced veterinarians have reported very favorably upon actual trial of common "engine oil," to which is added 4 or 5 oz. of sulphur per gallon. One application is reported as sufficient for ordinary cases. For unusual cases treatment should be repeated in about 10 days. This also is to be used for hand applications, not as a plunge dip.

(*d*) Crude petroleum is now recognized and especially recommended by our federal authorities. This is made into a 20 per cent mixture with soap emulsion. Take 20 gallons crude oil and 80 gallons water containing about 5 lbs. soap. Available water differs so much in different sections that it is difficult to specify exactly the amount of soap that will be needed. Any one wishing to use this method should first make up the soap emulsion and then test it with one quarter its bulk of oil to see if there results a good emulsion after thorough mixing. If the oil does not emulsify well, add more soap.

(*e*) The lime-and-sulphur dip is prepared as for sheep, page 118, except that we use 12 lbs. of lime instead of 8.

The lime-and-sulphur dip is probably not so reliable as an oil dip, but is used and recommended by some experienced authorities.

If a very large portion of the body surface is affected, either (*b*), (*d*), or (*e*) should be used as a dip; dips (*a*) or (*c*) may be used on about one quarter of the surface each day until the entire body has been treated.

Always treat apparently healthy skin to a considerable distance beyond the diseased border, in case of small areas.

Prognosis. — The prospect of recovery is good in recent cases, but if the horse has been long affected and the disease

LECTURE XXIV

CAUSES AND PREVENTION OF DISEASES

PARASITISM

Parasitism may be temporary or permanent, external or internal.

Parasites of domestic animals cause greater losses than is generally realized. Every stockman should be informed concerning the most common and serious parasites. He should be especially well informed concerning sheep parasites.

Temporary when only a portion of the parasite's life history is with one host.

Permanent when its whole life history is with the same host.

External or internal, i.e. affecting the body surface or affecting the internal organs.

General classes. — In studying diseases of domestic animals, we deal mainly with two general classes: worms and arthropodes.

Worms. — Invertebrates with soft contractile bodies, either composed of similar rings or nonarticulated; excretory organs in pairs opening externally. Members of this group affect many of the internal organs and superficial parts as well.

Arthropodes. — Invertebrates, limbs jointed, bodies composed of dissimilar rings. In this group also we find both external and internal parasites.

Sources and causes of parasitic diseases. — Parasites may be received into the digestive apparatus with food or drink; they may gain entrance through the respiratory tract,

through the broken skin, or there may be external infection by contact.

Predisposing causes. — Species of host; age of host; condition of host; season of year and climate. Most animal parasites are enormously prolific, but very many eggs and immature forms are destroyed. Others never reach their proper host. Female louse may become ancestor of 10,000 lice in eight weeks; female itch mite may be ancestor of 1,000,000 in three months, or a certain tapeworm will furnish 150,000,000 eggs in one year.

How nourished. — Parasites often live on the exudate or excretion which results from their presence. Some have mouth and digestive organs; *e.g.* roundworms of the intestines. Others receive their nourishment by surface absorption or osmosis; *e.g.* tapeworms.

Effect on health of host depends on the organ or organs invaded; the rapidity of multiplication; the amount of nutrition used by parasite, and amount of irritation caused.

Intestinal parasites cause trouble by obstruction; by irritating and abstracting blood from the mucous membrane; by mechanical irritation, and by using nutrition. Hence we have symptoms of indigestion, colic, and unthrift.

Liver parasites cause jaundice and general anæmia.

Lung and bronchial parasites cause bronchitis or pneumonia.

Parasites in the blood vessels cause disease of the vessel walls, and may indirectly cause obstructions and colic.

Parasites in the brain are more rare and usually fatal.

Parasites in muscular tissue may cause little disturbance to the animal host, but be very serious to human health; *e.g.* pig measles, trichina, actinomycosis (lumpy jaw).

General prevention. — Parasitism would be impossible if everything that comes in contact with the animal body were free from parasites. Saddles, harness, blankets, posts, and fences are the usual agents which spread Texas itch or mange among horses; round intestinal worms generally gain entrance in the egg or immature form, with the water drank.

Ponds, wells which receive surface drainage, sluggish streams and marshes, should therefore be regarded with suspicion. Sound animals should not be allowed in sheds, yards, or barns where animals diseased by external parasites, like lice or scab mites, have been, until such structures have been disinfected. Dogs are dangerous factors in sheep pastures, because of the tapeworms which they furnish to sheep. Intestinal worms which appear in the manure of horses should be destroyed with boiling water, — not merely crushed and thrown away.

General treatment. — Medical treatment must be such as will destroy or remove the parasites. Medicines may aid us in removing parasites by suffocating them, *e.g.* as with oils; or by poisoning the parasites; or by caustic or irritating chemical effect on the bodies of the parasites. Many parasites disappear by means of their own activity and habits; *e.g.* ticks, bots in horses, grubs in backs of cattle, and grubs in the nasal passages and head cavities of sheep. It is well to remember also that many parasites can resist stronger medicines than the organs or tissues they invade; *e.g.* bots in the horse's stomach.

EXTERNAL PARASITES

Most serious are the following: itch, mange, and sheep scab (due to mites), lice, ticks, flies, and ringworms.

Mite diseases (*acariasis*). — The various forms of itch or mange in horses, cattle, and hogs; scab in sheep; scabies in cats and dogs are all similar in cause, contagiousness, prevention, damage done, and in treatment. These diseases are caused by minute animal parasites. See Horse Mange, Lecture XXVI.

Causes. — Three types of mites, or acari, affect man and the lower animals, all very small: (*a*) sarcoptes, (*b*) psoroptes, (*c*) symbiotes. Each species of animal seems to have its own species of each of these varieties of mites.

The horse does not take mange from cattle or scab from sheep, and so it is with other animals.

Sarcoptes burrow channels and live in or beneath the skin. The eggs are laid and young hatched in these channels.

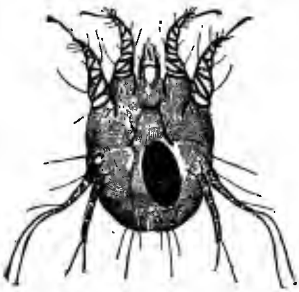

FIG. 38.—MANGE MITE.
The cause of one form of horse mange. *Psoroptes communis equi.*

Psoroptes live on skin surface. They can move around on the surface and spread rapidly.

Symbiotes affect regions near the feet and move about very little.

Diagnosis of mite disease is made on the condition of the skin, which becomes dry and wrinkled or leathery, with hairs partly gone; intense itching and the mites may be found among scales and roots of hairs, by standing the patient in the hot sun on the south side of a building, or by scraping off some of the diseased skin on a piece of black cloth and laying this in the hot sun. The mites may then be seen with a lens.

To find the sarcoptes, it is necessary to scrape deeply.

FIG. 39.—CATTLE LOUSE. FEMALE.
Haematopinus eurysternus.

General treatment. — For mite diseases the treatment is essentially the same for all animals. Scrubbing brush, with soap and warm water, is a great help, and then some application to kill the mites. Sheep are dipped, larger animals are usually bathed. Shearing of sheep is almost necessary to satisfactory treatment. Clipping larger animals is quite an aid. Treatment must be thorough and directions followed. Sheep must go under, head and all. (See Mange and Sheep Scab, pages 112 and 119.)

General prevention of all forms of acariasis is merely the prevention of a skin infection. Generous feeding is a good

prevention for many of the parasitic diseases, because it does not allow animals like colts and calves to become thin and weak, and thus easy subjects for parasitic invasion. Tonics are frequently valuable to build up strength and increase the resisting powers.

DISEASES — PARASITIC

LECTURE XXV

SHEEP SCAB

SHEEP scab is the result of irritation caused by little animal parasites as they burrow tunnels into the skin or puncture it from the surface. There are three types of these mites and three types of the disease which they cause. One variety of these mites produces body scab, another produces head scab, and a third produces foot scab. Body scab is by far the most common and most serious economically.

BODY SCAB

General history. — Body scab is caused by mites which have free power of movement (*Psoroptes*). This is the most common and serious type of sheep scab, because it spreads most rapidly over the individual body, and also spreads most rapidly through the flock.

This disease appears insidiously, and is liable to become quite serious before being noticed by the owner. The parasites which cause this type of the disease do not tunnel into the skin, but they cause intense irritation by reason of their presence and mode of life beneath the scabs. The owner will usually remember, after he has become aware that body scab exists in his flock, that his sheep have seemed uneasy and some of them have been rubbing and biting themselves occasionally for some time.

The parasites live beneath the crusts after the disease is well under way, and constantly migrate outward, while the skin slowly heals in the center. The fleece of scabby sheep

is usually rough, the wool is matted in places and easily rubbed off. The parasites which cause this form of the disease confine their work almost exclusively to parts of the body where the wool is long and thick.

How spread. — This form of the disease spreads rapidly through the flock; partly because of the location of parasites upon the body of the sheep, and partly because of the freely moving habits of the parasites. As a rule, the disease spreads more rapidly in autumn and winter, because the wool is then long and thick, furnishing favorable conditions for the parasites, and because the sheep are kept in closer contact at these seasons. The disease makes more rapid progress and is much more fatal with the weaker sheep. These parasites may be transferred from one sheep to another in a great variety of ways; for instance, tags of wool may be rubbed off and dropped almost anywhere. Diseased sheep infect posts and fences by rubbing against them, and the parasites escape from one sheep to another while the sheep are in close contact in yards and sheds.

These parasites may revive and become infectious after a short exposure to severe cold weather, but are soon destroyed by alternating changes of heat and cold. They may live three to four weeks, at ordinary temperatures and under ordinary conditions, around stables and sheds. Some authorities say they do not live longer than two or three weeks apart from the sheep's body, but it is certainly wise to extend this period to three or four weeks for safety.

FOOT SCAB

The disease caused by these mites (*Symbiotes*) appears on the feet and limbs. The diseased area extends very slowly, but may eventually reach the body. This form of scab spreads very slowly from one animal to another, and is therefore much less serious than body scab. Sheep having this disease are apt to be almost constantly stamping and pawing.

Local treatment. — Any of the sheep dips recommended for body scab are effective for this form of the disease. A 10 per cent solution of the creolin is simple, safe, and easily applied.

Any dip or ointment that will kill the parasites is sufficient early in the disease, but it may be necessary in old cases to soften the scabs by a little oil or a thorough scrubbing with brush and hot soapsuds. (See treatment.)

HEAD SCAB

The mites (*Sarcoptes*) which cause this type of the disease burrow tunnels in the skin. The eggs are deposited in these tunnels and there hatched. This type of the disease usually shows its first symptoms around the lips or nostrils, but may appear on almost any portion of the head. Occasionally it invades the neck and other portions of the body where the wool is short. This form of scab is much less common and less serious than body scab.

GENERAL PREVENTION

Prevention is more important than treatment in any case where it can be secured, because it is surer, it is cheaper, and is usually much easier to administer than medical treatment.

Spread of scab. — Whether the disease spreads rapidly over the body or not depends to some extent upon the thriftiness or unthriftiness of the individual animal. When sheep are fat and the wool is well supplied with yolk, this disease spreads slowly, and is much less serious. The infection is frequently made when one sheep rubs against posts or fences where scabby sheep have previously rubbed. In the latter case the mites are first transferred from the diseased sheep to the post, and then from the post to the healthy sheep. In other cases the mites are transferred when a diseased sheep rubs against a healthy one.

Exposure resistance. — The mites which cause foot scab

and body scab have considerable vitality, being able to withstand exposure at moderate temperatures from one to two or even three weeks under favorable conditions, possibly longer. They die sooner in a dry atmosphere than moist. Cases are on record where sheep seem to have become infected with scab in places where sheep had not been

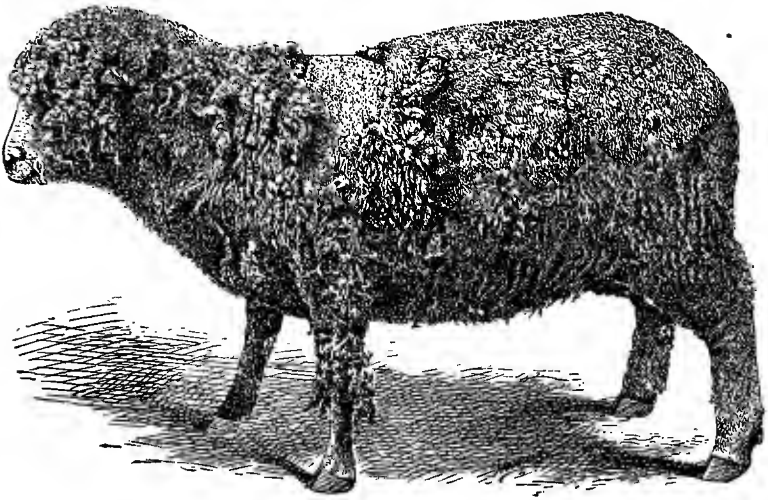

Fig. 40.—A Plain Case of Sheep Scab.

kept for many months. The history of these cases, however, is not well understood, and it is difficult to say positively how long mites or their eggs may preserve vitality under favorable conditions.

Precautions. — Scabby sheep should not be driven over any public highway. Pens, sheds, and yards which have held scabby sheep should be thoroughly cleaned and disinfected, and unless the disinfection is very thorough they should not be used for sheep until at least four weeks have elapsed. It is supposed that a hard rain will practically disinfect ground surfaces, but not fences and posts. Fields and pastures in which scabby sheep have been held should not be used again until after an interval of several weeks, and preferably not until after a heavy rain.

GENERAL SYMPTOMS

History and diagnosis. — At the point of first infection there appears a small, congested area, showing plainly the result of irritation caused by the parasite. Then there appears a little pimple, soft on top, which ruptures and a little fluid escapes. Dust and other foreign matter collect in this fluid and the initial scab is started.

Affected sheep are usually uneasy and are seen to scratch against posts, rub against other sheep, and even bite the itching surface. The irritation is most noticeable when the

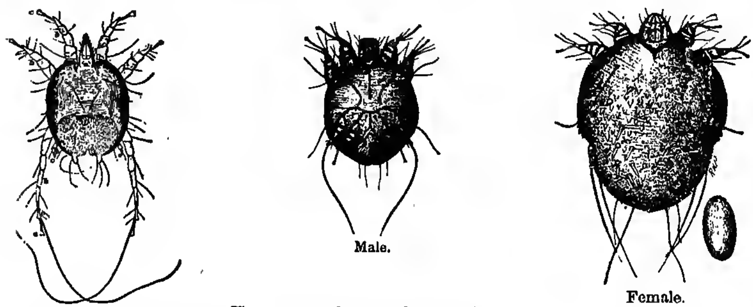

FIG. 41. — SHEEP SCAB MITES.

Psoroptes, male (*Curtice*). Body scab. Sarcoptes (*Lugger*). Head scab. Sarcoptes (*Pettit*). Head scab.

sheep are heated, as by exercise, or confined in a close room. At first the wool is noticed to hang in tags, the sheep begin to pull out portions of the wool with the mouth, and the skin becomes bare in small patches which gradually increase as the mites spread, irritating and inflaming the skin. To determine the presence of the mites, scrape off some of the scab and a little of the healthy skin near the border of the scab. Place these scrapings upon some smooth black surface in warm sunshine, and examine with a good hand lens. The mites may then be seen as minute white bodies. They are most certainly recognized when they are seen to move, and it is sometimes difficult to distinguish otherwise between the mites and particles of light-colored dust and epithelial scales from the skin surface. It should

be borne in mind when examining a case of head scab that the mites which cause this disease burrow beneath the surface of the skin, and it is necessary to scrape deeper than for ordinary body scab.

Possible mistakes. — It is well to bear in mind that certain other conditions may be mistaken for sheep scab, particularly disorders of the skin, produced by other external parasites; for instance, lice and sheep ticks. We have had in Minnesota an interesting outbreak of skin disease among sheep which on superficial examination resembled rather closely sheep scab, but was due to the awns of a certain wild grass (*Stipea sparta*), wild oats. It developed that these sheep had been pastured where this grass was abundant, and at a time when the awns were readily separated. These little spearlike bodies gradually worked their way through the wool into the skin, causing inflammation of the skin and considerable irritation.

TREATMENT

Suggestions. — Treatment is comparatively easy where there are but few sheep, but more difficult with large flocks. The size of the tank, material to be used, and method of dipping must depend upon the number of sheep, accessibility and expensiveness of different materials.

The dipping, as a rule, should be done after shearing, but it should be remembered that treatment for any parasitic disease of sheep should be given as early as practicable. Some good may be accomplished if the wool is parted by hand and care taken to get the medicine down to the skin, but it is the usual experience that dipping unshorn sheep is much less satisfactory.

The entire flock must be dipped; that is, those that are apparently well as well as those that are diseased. And the owner must bear in mind that, even after shearing, the wool may be a source of danger, and should be so kept and handled as to avoid the possibility of reinfection.

Dipping is effective only when it is thoroughly done. Tobacco, crude carbolic acid, arsenic, lime, and sulphur are the various ingredients that are commonly used in dipping for scab. The quantity of dip required per sheep varies from two to four gallons, according to the number of sheep dipped and the material used. Less dip is needed for shorn than unshorn sheep.

It is a good rule to use any dip at about 110 degrees F. and a good plan to rub the scabs with a stiff brush while the sheep are in the dip. Dipping should be repeated in 8 days, and in some cases it may be necessary to give even a third dipping after a second interval of 8 to 10 days.

For thorough work the entire flock should be shorn, then dipped and confined for 8 to 10 days in a place where there has been no scabby sheep for at least two months. At the close of this period of 8 to 10 days, the flock should be redipped and placed where there is no danger of infection. Sheep should be watered just before dipping.

Dips. — A great variety of dips have been recommended and successfully used. Several of the patent dips give excellent results, but these are usually more expensive than others and are objectionable, inasmuch as we do not know their composition. The following are perhaps as good as any: —

Lime-and-sulphur dip. — This is cheap and very effective for sheep scab. It has given good satisfaction when made and used according to directions.

Make this dip in the following proportions: ordinary sulphur 24 lbs.; unslaked lime 8 lbs.; water 100 gallons. The lime and sulphur are placed in a large kettle or other suitable container. Enough water is added to slake the lime and form a paste. After the lime is thoroughly slaked, add 30 gallons of water. The mixture is then boiled for 3 hours and allowed to settle overnight. The liquid should then be so drawn off as to avoid stirring up the sediment. A spigot placed about 4 inches from the bottom of the barrel or tank works nicely.

For use add enough water to make a total of 100 gallons. The ooze or sediment is not to be used on the animal body, but makes a good disinfectant for contaminated structures.

Lime and sulphur cannot be relied on to kill sheep ticks. Tobacco and sulphur or coal-tar dips should be used when there are both ticks and scab.

Coal-tar dips. — Dips of this class are now accepted by the Federal Bureau of Animal Industry when used in official strength. This strength is usually given on the package, and directions should be followed closely.

Texas dip. — What is known as the Texas dip is composed as follows: 30 lbs. tobacco, 7 lbs. sulphur, 3 lbs. concentrated lye, 100 gallons water. Allow the tobacco to soak in a portion of the water, which should be kept warm, for from 8 to 10 hours; then add the sulphur, remainder of the water, and concentrated lye, and boil for half an hour. Stir frequently while using.

Zundle's. — The following is a formula for a modification of Zundle's dip. (Modifications suggested by Dr. Kaiser.) For 100 sheep take the following: Tobacco, 13½ lbs. Soak for several hours in 66 gallons of water, then dissolve in this 8 lbs. of carbonate of soda and 4 lbs. freshly burned and slaked lime; then take 8 lbs. of softsoap and dilute with some of the hot tobacco infusion and add to the materials previously mixed; then add 4 lbs. crude carbolic acid; mix thoroughly. Use hot.

Dipping. — Each sheep should be kept in the dip at least two minutes by the watch, and each sheep to go under entirely at least once. Heavily pregnant ewes can be safely dipped if handled with care. In using any dip, no matter if proprietary or homemade, follow directions exactly. It is not uncommon for stockmen to have unsatisfactory results from the use of well-recognized dips, and it is usually because they try using the dip a little weaker than the directions call for, or because they were a little careless and hurried the sheep through the dipping vat too rapidly, or

by returning the sheep after dipping to infected pastures or yards.

Disinfection. — All structures that may have been contaminated should be cleaned and well disinfected unless sheep can be kept away from them for a long period, as previously indicated.

Any good dip should make also a good disinfectant for this use. In case a lime-and-sulphur dip is selected, then the "ooze" or sediment which would otherwise be discarded may be used.

LECTURE XXVI

HORSE MANGE

Causes. — Mange in horses is usually due to the irritation caused by a minute animal parasite, a mite, belonging to the group Arachnida. Specifically it is usually *Sarcoptes scabiei*, var. *equi*. This is one of the smaller mites practically invisible to the eye.

This particular species burrows tunnels into and under the skin. The eggs are laid and the young are hatched in these tunnels. On account of this tunneling habit, spread under the body surface is slow and the disease difficult to cure.

Symptoms. — The disease usually appears first on the head or side of the neck, and the first symptoms are small pimples and itching. The skin loses hair, becoming thickened, roughened, and perhaps wrinkled. Affected horses are much more uneasy at night, and particularly in a warm stable.

Treatment. — It is usually necessary to repeat treatment at least once and in bad cases several times at intervals of ten days. Treat all horses that have been exposed to infection, and watch closely for reappearance of the disease.

If the horses are halter broken, it is well to see that the scab is first removed by a thorough application of soft soap well rubbed in over the affected surface. The soap is left on for two or three hours and then washed off. The scab should then remove quite easily. Allow the skin to dry and apply one of the following treatments: —

(*a*) Creolin, or any of the cheaper coal-tar preparations, which are probably just as efficient, diluted with raw lin-

seed oil in the proportion of 1 to 16, and used for hand application and not as a plunge dip.

(*b*) The coal-tar preparations diluted with water in the official strength recognized by the Federal Bureau of Animal Industry (see directions on label).

(*c*) Experienced veterinarians have reported very favorably upon actual trial of common "engine oil," to which is added 4 or 5 oz. of sulphur per gallon. One application is reported as sufficient for ordinary cases. For unusual cases treatment should be repeated in about 10 days. This also is to be used for hand applications, not as a plunge dip.

(*d*) Crude petroleum is now recognized and especially recommended by our federal authorities. This is made into a 20 per cent mixture with soap emulsion. Take 20 gallons crude oil and 80 gallons water containing about 5 lbs. soap. Available water differs so much in different sections that it is difficult to specify exactly the amount of soap that will be needed. Any one wishing to use this method should first make up the soap emulsion and then test it with one quarter its bulk of oil to see if there results a good emulsion after thorough mixing. If the oil does not emulsify well, add more soap.

(*e*) The lime-and-sulphur dip is prepared as for sheep, page 118, except that we use 12 lbs. of lime instead of 8.

The lime-and-sulphur dip is probably not so reliable as an oil dip, but is used and recommended by some experienced authorities.

If a very large portion of the body surface is affected, either (*b*), (*d*), or (*e*) should be used as a dip; dips (*a*) or (*c*) may be used on about one quarter of the surface each day until the entire body has been treated.

Always treat apparently healthy skin to a considerable distance beyond the diseased border, in case of small areas.

Prognosis. — The prospect of recovery is good in recent cases, but if the horse has been long affected and the disease

wood creosote, which is ordinarily dispensed. Coal-tar creosote is cheaper and more satisfactory. It is given as a 1 per cent solution; *i.e.* 1 oz. of the creosote to 99 oz. of water in doses proportioned to the age and size of the sheep. Lambs 4 months old take 2 to 4 oz. Older sheep take 3 to 5 oz. If there is any reason to suspect the presence of worms in the intestines, then thymol should be added to the creosote treatment. The dose of thymol is from 30 to 100 grains. Each dose of thymol is to be added to the dose of creosote after the latter has been mixed and measured, and should then be given immediately. Only fresh crystallized thymol should be accepted.

Bluestone (copper sulphate) has been accepted as one of the most satisfactory treatments for this trouble, but it needs to be given in carefully regulated doses. This medicine may be made up as follows: Dissolve 1 lb. (avoirdupois) of fresh powdered bluestone in 9 gallons of water. For this treatment the animal must be kept off feed from 20 to 24 hours. The dose for a lamb 6 months old is 40 c.c.; sheep 12 months old, 60 c.c. (about 2 oz.); 18 months, 80 c.c.; 2 years, 90 c.c. When the bluestone treatment is used, sheep should receive no water on the day that they are treated, either before or after treatment.

Gasoline has been much used in recent years and with good results. It is cheap, easily obtained, and easily given. Gasoline treatment should be repeated on three successive days. Sheep should be given the gasoline about ten o'clock in the morning, having received no feed since at least the evening before — 24 hours' fasting is better. Three hours after treatment they are given feed and water. Then in the evening they are put up again without feed or water and given a second treatment the next day about 10 A.M., and again on the third day, following the same procedure. Each dose for the 3 days is measured separately and given in linseed oil or milk, but not water.

Large lambs take about 2 to 3 teaspoonfuls; sheep and calves take about 1 tablespoonful. Enough gasoline should be given to produce slight intoxication.

Drenching sheep. — For giving medicine to sheep, a drenching tube should be used or a large piston syringe, or a long-necked bottle. A very satisfactory drenching tube may be easily made with an ordinary tin funnel, which is inserted into one end of a rubber hose about 3 feet long and about one half inch in diameter. A piece of brass or iron tubing 4 to 6 inches long is inserted into the other end of the tube. The metal tube is placed in the animal's mouth between the back teeth; the funnel end is held at a convenient height and medicine poured slowly into it. It is better to give the medicine with the sheep standing on its feet, because actual experiment has demonstrated that while the animal is in this position more of the medicine goes directly to the fourth stomach, where it is needed. The head must be raised not too high — not higher than level face; otherwise there is danger of passing medicine into the lungs.

Prevention. — Sick animals must be killed or removed from the flock and confined where there is no drainage to the pasture or yard used by other sheep or cattle. Water should be taken from wells that do not receive surface drainage from large lakes or from running streams, although stagnant pools are probably not so dangerous in this connection as commonly supposed. The tank or trough should be high enough so that the water cannot possibly be contaminated from droppings. High and well-drained pasture is always safer than low pastures so far as internal parasites in general are concerned. Infected pastures should be burned over thoroughly and regularly for the purpose of destroying eggs and young worms.

It should be borne in mind that when animals are well fed and well nourished, they are better able to resist the invasion of any parasite.

LECTURE XXX

VERMINOUS BRONCHITIS, NASAL GRUB, AND CATARRH

VERMINOUS BRONCHITIS

Cause. — This is a disease of the bronchial tubes and lungs, caused by special species of minute roundworms. The worms are similar in different domestic animals, but each animal has its own species. They vary from about one to three inches in length and are white or reddish to brown in color. There is therefore little danger of infection from one kind of domestic animals to another. Sheep, goats, cattle, and pigs are subject to this disease. Older animals may be seriously affected, but more frequently carry the parasite without evident injury.

Life history. — The mature worms, eggs, and embryos are all found in the bronchial tubes. These may be coughed out, and many ultimately reach pools or small ponds of stagnant water. The larvæ are usually swallowed with the food or drink, and some of them ultimately reach the trachea, probably by way of the larynx. It is possible that the eggs or dried embryos may be inhaled directly with particles of dust. Infection occurs mainly in the spring. The parasitism remains long dormant, slowly developing until fall. The disease seems to be especially common in dry years, or in wet years following dry years. Embryos and eggs are very resistant and tenacious of life at all stages. Some species have been shown to survive for months as embryos in water or moist earth. If dried at certain stages of development, the embryos may revive in moisture after a year. This explains the tendency of verminous bronchitis

to appear in dry seasons, or in wet seasons following dry seasons.

Symptoms. — At first there is a bronchial catarrh; later a chronic anæmia and pallor with progressive loss of flesh and strength and with shortness of breath. There is a cough which at first is rather harsh, and later very weak. The cough is worse when animals are excited and when they move round. Sometimes small balls composed mainly of worms may be coughed out and actually seen. Respiration is difficult and in some cases wheezing. Calves are able to resist rather longer than sheep.

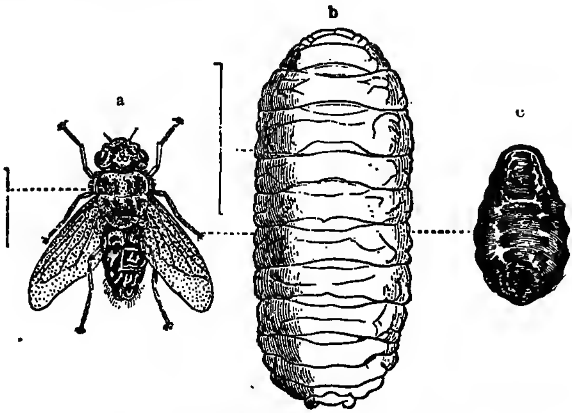

Fig. 48. — Sheep Gadfly (*Œstrus ovis*).
Commonly called "nasal grub." a, Adult; b, larva; c, puparium.

On examination post mortem there may be found masses of minute threadlike worms in the trachea and bronchial tubes, with a considerable quantity of purulent and viscid liquid in the tubes. Some lobules of the lungs may show very marked pneumonia. There may also be tubercles resembling those of tuberculosis, near the surface of the lungs, and also throughout the lung substance.

Treatment. — For the present we must consider this as generally doubtful of success. Treatment by injection of medicines directly into the trachea has been tried and recommended in some cases, but is very apt to prove un-

satisfactory. In cases of valuable sheep the following is worth trial: —

Olive oil, 100 grams.
Turpentine, 100 grams.
Carbolic acid, 2 grams.

Give 10 grams per day for 3 days. Each dose is given by a large hypodermic syringe and injected directly into the trachea.

Benzine has been tried and reported successful by several. Inject about 1 dram (1 teaspoonful) slowly into the trachea. Use an ordinary hypodermic syringe and inject directly through the side of the trachea between two rings. The sheep must be held flat on the side at the time of injection and for five minutes afterward, and with the head as low as possible. It would be wise to treat but a few sheep at first and note results.

Prevention. — Change pastures often; keep sheep upon forage crops and upon frequently changed pastures. Avoid ponds and well water which receives drainage from pastures, feed lots, or barnyards.

NASAL GRUB (GRUB IN THE HEAD)

This is a very poor name for a disease, but is the only one commonly understood and is used here for that reason.

Cause. — This disease is caused by a parasite (*Œstrus ovis*) which inhabits the various cavities of the head which communicate with the nasal chambers. See Fig. 48.

Life history. — The mature fly resembles the well-known botfly of the horse, is of a dirty yellow or grayish yellow color, and appears in the middle of the day from July to September. The young larvæ are deposited about the nostrils of the sheep, from whence they crawl up into the various cavities of the head, including the horn cores, and may even reach the brain substance. They mature in about nine months. The developed grubs work out, escaping from the nose during the spring, from March to May. They then

pass through another stage before the adult fly appears, which occurs in six or seven weeks from the time the grubs escape from the nose.

Symptoms. — A few larvæ may not cause any evident disturbance. When present in the head sinuses in larger numbers, the parasites cause great irritation with marked catarrhal discharge from the nostrils, especially in the spring. The affected animals may refuse to eat well and even cough. The sheep sneeze, shake their heads, and rub their noses and faces against their feet or other objects; sometimes there are attacks of vertigo, and the walk may be unsteady or irregular; severe cases develop convulsions and die. On examination post mortem, grubs are found in the various openings and chambers of the head, and the mucous membrane lining these cavities is inflamed.

Treatment. — Medical treatment under ordinary circumstances is not practical, and prevention is very difficult to apply on a large scale. Before the sheep are turned out in the morning their noses may be smeared with tar or a mixture of tar, turpentine, and fish oil. They may be forced to take their salt through a large hole bored in a log or a plank, the tar being smeared around the edges of the hole so that, when the sheep take their salt, they get a little tar around the nose and mouth.

CATARRH IN SHEEP

Causes. — Catarrh in sheep is so frequently associated with nasal grub that it seems best to insert a brief mention of it in this connection.

Simple catarrh in sheep is usually due to cold rains, imperfect ventilation and damp quarters, or undue exposure after early shearing. In other words, it is simply a case of catching cold. Many cases of catarrh are due to parasitic invasion of the nasal chambers and head sinuses. Simple catarrh is not contagious, although many cases may appear simultaneously, due to common causes.

Symptoms. — The affected sheep are noticed to be sneezing, with discharge from the nose and eyes, and sometimes coughing. The nasal discharge is thin at first, gradually becoming thicker. Some cases become chronic, and especially when the subjects are weak and unthrifty. The inflammation of the nasal mucous membrane may then extend into the head sinuses, and cause extensive collections of pus, and also extend down the mucous membrane lining the trachea.

Prevention. — First of all, abundant ventilation at all seasons. Sheep are very frequently housed too closely in winter. The interior of the building becomes very damp, and the conditions in general are unwholesome. Healthy sheep do not need much protection in the winter-time, so far as warmth is concerned. If they are well protected from cold rains and snows and from cold winds, they are most thrifty with abundant ventilation. Sheep that are shorn early in the spring need careful management for a time in order to prevent their catching cold.

Treatment. — The sick animals must have shelter. Their quarters must be dry, reasonably warm, and well ventilated. They must be well fed. The medicinal treatment should consist mainly of tonics; for instance, a simple, bitter vegetable tonic, like gentian root, which may be given in a powdered form in the feed two or three times daily, — about one dram per sheep.

INFECTIOUS DISEASES

LECTURE XXXI

ACTINOMYCOSIS OR LUMPY JAW

Definition. — This disease is commonly called either lumpy jaw or bighead. It is characterized by the development of peculiar enlargements, usually around the head. The disease may also affect internal organs.

The tumors and abscesses which characterize this disease probably have a common origin, being due to the presence and activity of a vegetable organism known as actinomyces. When these abscesses are opened, there is usually found, in the interior, pus containing minute yellow or white grains, sometimes very abundant. These small grains may be bedded in the diseased soft tissues of the tumors. Seen under a microscope, this fungus under certain conditions seems to be composed of radiating club-shaped particles. As the fungus multiplies and spreads, the tumor growths increase. The tumors are usually very firm on account of the large amount of connective tissue which they contain. The interior of the tumor is usually somewhat honeycombed with the fungus colonies in the spaces. Animals affected are chiefly cattle, horses, and sheep.

Relation to public health. — Human beings are evidently susceptible to inoculation from this disease, but as the affected parts of diseased carcasses are not commonly used as articles of human food, and animal meats as a rule are cooked before being eaten, there is ordinarily comparatively slight danger for human beings. The government meat inspection regulations pass carcasses which are but slightly and locally diseased, and condemn those which are extensively and generally diseased.

Parts involved. — These are commonly the bones of the upper and lower jaws, the soft tissues between the two branches of the lower jaw, and the tongue. These are the external or superficial portions of the body most commonly affected. This disease sometimes affects the lungs and other internal organs, and might be mistaken for tuberculosis. The lung symptoms, as seen on examination post mortem, vary so much that it is rather difficult to describe them.

FIG. 49. — ACTINOMYCOSIS — LUMPY JAW. (*M. H. R.*)
Note the enlarged jaw and the raw, granulating tissue exposed.

Sometimes the lungs resemble those seen in ordinary bronchopneumonia. In other cases considerable areas of the lung tissue are changed to a gray mass, soft to the touch. In still other cases there are developed distinct abscesses.

This disease is usually of slow development. A small swelling appears somewhere about the head, perhaps under the tongue; or the bones of the face near the teeth begin to bulge slightly outward and the enlargements continue very slowly. The animal may remain thrifty for a long

time, or indeed until the disease involves the teeth, tongue, or other organs and interferes directly with nutrition.

Prevention. — There is so little known concerning the life history of the parasite and the methods of infection that a study of prevention can be only partially satisfactory. It is generally agreed that animals develop lumpy jaw only after inoculation, *i.e.* the germs find entrance through some cut or scratch in the skin; through the mucous membrane of the mouth on account of diseased teeth; or through some abrasion of the mucous membrane of the mouth, gullet,

FIG. 50. — ACTINOMYCOSIS. (*M. H. R.*)
Inferior maxilla of cow shown in Fig. 49.

or stomach. It is also generally agreed that the parasite is usually taken in with the food. It is possible that this parasite may live through one stage of its development, or even multiply, upon the surface or in the tissues of some of the common fodder plants, particularly barley and rye.

An animal with a discharging abscess about the head would of course infect food in mangers, feeding troughs, and grass in the pasture; thus offering abundant opportunities for infection. Pastures wherein cases of lumpy jaw seem to develop rather commonly should be placed under cultivation or avoided. Animals with discharging abscesses should be killed or confined.

Treatment. — There are three possible lines of treatment: surgical, caustic, and internal medication.

Surgical treatment. — This should be undertaken only by a trained veterinarian, on account of the large blood vessels and other important structures involved.

Caustic. — Dr. Detmers, formerly of the Ohio Experiment Station, described several years ago a method of local treatment, in which he proposed to remove the tumor by

FIG. 51 — ACTINOMYCOSIS. (*M. H. R.*)
A badly diseased upper jaw.

the deeply caustic action of powdered arsenic. He reported a large number of cases treated with satisfactory results. His method was essentially as follows: —

The *method* is simple. One half ounce of powdered arsenious acid is added to two drams of caustic potash, one half ounce of powdered gum arabic, and one ounce of distilled water. This makes a thick, sirupy mass. The mixture is kept in a wide-mouthed bottle and labeled "*Poison.*" Take a small stick of hard wood and sharpen it to a point somewhat resembling the dulled blade of a dagger, the tapering end being made as smooth as possible. An incision is made into the abscess pocket, or into the interior of the tumor, as the case may be. Then by means of this piece of wood shove in small masses of absorbent cotton, carrying as much as possible of the arsenic paste. These wads

of cotton are placed quite deep in the substance of the tumor. If the stick is smooth enough, it will usually draw out and leave the cotton; if not, the cotton can be shoved off the end by the use of another small stick. From two to six of these pieces of cotton are inserted into the cavity. Within a few days the tumor swells considerably. Later on a large surface seems to become insensitive, the tissues having been destroyed by the arsenic. Finally this dead mass separates and sloughs out.

The *time required* for the complete removal in this way varies from six to ten weeks, but this operation has the advantage of requiring but one treatment. This method is of course applicable in cases where only soft tissues are diseased. The writer has tried this method with satisfactory results; the only objection, and that seemed to be quite a serious one, was that so much time was required for complete removal. It should not be forgotten that while the slough is separating, the wound may become infected with maggots.

Internal medication. — This treatment is by the internal use of iodide of potash, which is given by the mouth either as a drench or dissolved in the drinking water. Very many cases may be treated with a good prospect of success in this way.

The *dose limit* is about one fourth dram per one hundred pounds live weight. Each dose is dissolved in from one half to a pint of water and given as a drench or dissolved in the drinking water. This dose is given once daily until the animal seems to get off feed and discharges freely from the eyes and nose, indicating something of a *catarrhal disturbance* of these mucous membranes. These conditions indicate that the treatment should be discontinued for three or four days. During this period a mild cathartic of epsom salts should be given, about one pound to 1000 pounds live weight. This should be dissolved in water and given as a drench. The iodide treatment may then be continued for another period of six to ten days, when it may be necessary

to discontinue again and give another dose of epsom salts. Treatment should be continued until the tumor is reduced to about one third of its original size; it may then be discontinued.

The *time required* for successful treatment in suitable cases varies from four to seven weeks. It is not advisable to undertake the treatment of any case where there is very great bony enlargement, or where there is reason to suppose that there is a very serious disease of the bony structure.

LECTURE XXXII

ANTHRAX[1]

History. — One of the oldest diseases known to medical science.

Distribution. — Almost world-wide. In the United States anthrax is sporadic in the North, East, and West; but in the South, more particularly in parts of the Lower Mississippi Valley and along the coast of the Mexican Gulf, it seems to be enzoötic.

Animals affected. — All of the domestic farm animals are more or less susceptible to anthrax. The disease is transmissible, and very fatal to human beings, chiefly by inoculation, but may be conveyed by means of food or water, or through the inhalation of dried spores, which afterwards develop into the rod-shaped organisms in the blood.

Cause. — Anthrax is caused by a microscopic rod-shaped organism or germ, the *Bacterium anthracis*. The rod stage of the organism is found in living blood, immediately after death, while the spore stage occurs outside of the body. Some authorities claim that this germ may, under certain conditions, live upon decaying vegetable matter outside of the body. The rod is more easily destroyed than is the spore. Where conditions are favorable, the spore may retain its vitality in surface soil, manure, in infected feedstuffs, blood, hides, hair, and wool of anthrax victims for long periods, and be capable of causing fresh outbreaks.

Modes of infection.

(1) *By the respiratory tract.* — Dried spores may be inhaled and reach the general circulation by way of the

[1] **This lecture contributed by Dr. W. H. Dalrymple, of Louisiana.**

capillaries of the lungs. Human beings following certain occupations, as wool sorting, mattress making, etc., obtain infection in this way more often than do the lower animals.

(2) *By the skin.* — When infection is introduced through the skin, there results the condition known as external anthrax, carbuncular disease, inoculation anthrax, or malignant pustule. This may be occasioned by insects, especially the blood-sucking varieties, as the different horse or gad flies (*Tabanidæ*); probably, also, by some varieties of the mosquito. The infection may come through wounds made by infected instruments or utensils; or by wounds coming in contact with virulent material. In the Lower Mississippi Valley the external form occurs very frequently, and some outbreaks extend over considerable territory, among horses and mules, on account of the vast numbers of horseflies during the summer months.

FIG. 52. — BACTERIUM (BACILLUS) ANTHRACIS. (*M. H. R.*)
The specific cause of anthrax.

(3) *By the digestive tract.* — The internal, or intestinal, form of anthrax is generally produced through taking the virus in contaminated food or water.

Methods of introduction and spread. — Anthrax may be introduced by imported hides, hair, wool, etc., from foreign countries infected with anthrax. Fertilizing materials manufactured from animals affected with the disease may be a source of infection. Running water may become contaminated and spread infection along its course. The refuse water from tanneries has been known to disseminate infection from anthrax hides. The wind may sometimes be responsible for the conveyance of dried anthrax spores. Insects, after feeding upon infected blood and tissues, may transmit the virus to healthy animals at a distance through fresh wounds or sores, or by puncturing the skin. Insects may probably, also, infect food materials in troughs and mangers, by conveying virulent matter on their bodies and feet. Carrion birds, through the medium of their excre-

ment or soiled feet, may infect pastures on which they alight. Carnivorous and omnivorous animals, as dogs and hogs, running at large, after feeding upon anthrax carcasses, may carry away virulent blood on their feet; and if these animals die themselves, they become fresh centers of the disease.

Foodstuffs, as pastures, and commercial feeding materials, such as the cereal grains and their by-products, hay, etc., raised upon lands infected with anthrax spores, may carry those spores and spread the disease. Human beings coming in contact with virulent anthrax material, and having their clothes, shoes, hands, etc., soiled thereby, may easily spread the disease to animals. Neglect to properly dispose of anthrax carcasses is, perhaps, the factor most responsible for the continuance and spread of anthrax.

Period of incubation. — The time that elapses between infection and symptoms depends upon the method of infection and amount of infective material introduced, and may range from a very few hours to several days.

Symptoms.

Pulmonary anthrax. — This form is probably not of frequent occurrence in the lower animals. Dried spores may, however, be inhaled from infected hay, whole or crushed grains, etc. There are: suddenness of attack; elevation of temperature, 104–108 degrees F.; lack of appetite; difficult respiration; redness of visible mucous membranes; discharge of blood from respiratory tract; unsteady action of the heart; small and frequent pulse; staggering movements; convulsions, and death resulting from asphyxia. This form is confined chiefly to the herbivora.

External or cutaneous anthrax. — There is swelling at point or points of inoculation (carbuncle or malignant pustule), with considerable local edema (localized watery swelling). This is painful and hot at first, but afterwards becomes cold and insensitive. If inoculations have been made by insects, the carbuncles may be numerous over different

parts of the body. The swellings extend in the connective tissue along the course of the lymph vessels and glands.

This form is seen most frequently in the thinner-skinned herbivora — horse, mule, etc.

Internal anthrax. — There is sudden seizure, great depression, and prostration; rapid elevation of temperature; stupor; muscular weakness and twitchings; vertigo; hurried respirations; increased heart action, the organ beating tumultuously; visible mucous membranes, dark red or a bluish red color; sometimes the coloring matter of the blood passes in the urine. This form usually terminates fatally.

The horse, ass, and mule may exhibit symptoms of internal anthrax without visible external swellings when the virus has been taken into the body with food or water.

In cattle the internal or acute anthrax is most frequently seen, and without external localized swellings. Swellings are, however, sometimes observed, either as the result of inoculation or during the course of the acute attack.

In the hog the external manifestations are usually confined to the throat; and there are generally other symptoms of a specific fever present. As a rule, death takes place from asphyxia. The hog becomes infected from eating anthrax carcasses; and the disease is most frequent in this animal during epizoötics.

Poultry. — There is difference of opinion with regard to the susceptibility of poultry, on account of their normally high temperature, which, it is claimed, is unfavorable to the development of the anthrax organism.

Course of the disease. — In isolated cases, in limited outbreaks, and in the early part of an epizoötic, the course of the disease is usually very acute and rapid; while, toward the termination of an outbreak, anthrax seems much less fatal, many of the affected animals recovering. Or, in other words, the virulence of the disease seems to become weakened toward the end of an outbreak.

Examination post mortem. — On account of the danger to the operator, and of spreading the disease, through the in-

fectivity of the blood, post-mortem examination of an anthrax carcass is dangerous, and is not recommended, except when undertaken by an expert familiar with the possible untoward consequences.

Diagnosis. — This is safest and most reliable by microscopic examination of a small quantity of blood from the extremities (ear of larger animals, or a foot of the smaller), or by inoculation of the small susceptible animals (guinea pig) with anthrax blood, and subsequent microscopic examination of the blood of inoculated cadaver.

Treatment.

Therapeutic. — *Internally,* coal-tar products have been recommended. *Externally,* good results have been reported from injecting the carbuncles (swellings) with a 5 per cent watery solution of pure carbolic acid, or the requisite strength of some other effective germicide.

Preventive. — Vaccination by the Pasteur method may be practiced annually in anthrax districts, or in sporadic outbreaks, as required. Prevention in this way is very important.

There should be cremation of carcasses; thorough disinfection of premises (stables, sheds, yards, etc.); drainage and cultivation of infected lands; destruction of horseflies, mosquitoes, etc.; drainage of pools and stagnant water where these insects breed or frequent; and effective live-stock sanitary legislation.

LECTURE XXXIII

SYMPTOMATIC ANTHRAX

THIS disease is also known as blackleg, black quarter, etc.

Definition. — A fatal infectious and enzoötic disease of thrifty young cattle. It is apt to appear year after year on certain pastures or along certain valleys. Cattle over two years of age are not usually affected.

Cause. — A short spore-forming bacillus (*Bacillus Chauvœi*). This germ is very resistant, being able to remain virulent for years — under favorable conditions. Infection is usually made by inoculation, either through the skin or mucous membranes; more commonly through the former.

Symptoms. — Local and general.

Local symptoms. — There is usually a pronounced swelling involving either the front or hind quarter. This swelling is characterized by crepitation as one passes the hand over it, due to an accumulation of gas in the loose subcutaneous tissues. The swelling does not extend below the hock or knee. An incision into the swelling reveals the presence of dark, frothy blood, with peculiar acetone odor. This swelling is not invariable. Some cases, especially those which appear at the beginning of the outbreak and die very suddenly, may not show the characteristic swelling.

Constitutional symptoms. — The constitutional symptoms are usually acute and develop rapidly. The animal is dull, without appetite. It shows high fever and marked debility. The constitutional symptoms may last from one to three days, and the case usually terminates fatally. The fever may reach 106 or even 107 F. There is lameness in those cases which show local swellings of the front or hind quarters.

Examination post mortem. — This reveals a tumor filled

with dark, frothy blood with fetid odor and more or less gas. The spleen is normal, and blood from the general circulation is also apparently normal, clotting readily on exposure to air. In these features of normal spleen, normally clotting blood, and gas-filled tumor, this disease differs from true anthrax.

Prevention. — As soon as the disease appears cattle under two years of age should be promptly changed to another and preferably higher pasture. If the young cattle have been on dry food, then this should be changed.

Vaccination is now conceded to be very satisfactory and thoroughly practical. There are a number of commercial blackleg vaccines on the market that are quite reliable. The Federal Bureau of Animal Industry is supplying what is known as the government blackleg vaccine. This vaccine is quite satisfactory. Method of vaccination depends upon the kind of vaccine used. Directions usually accompany each shipment from any of the reliable makers.

VACCINATION

The vaccine. — The Bureau or Government Vaccine consists of a brownish powder furnished in packets of ten and twenty-five doses each, made from the muscle of animals affected with blackleg. It is prepared by drying the muscle, grinding and heating to a temperature which lowers their virulence but does not destroy the bacilli.

Preparation. — The needed outfit consists of a graduated hypodermic syringe of about 5 c.c. capacity and preferably with rubber or asbestos valve; rather short, stout needles of good caliber, and sharp; a small mortar and pestle, absorbent cotton for filtering, and a measure graduated for cubic centimeters.

All these must be sterilized by boiling or otherwise before using. The vaccine is prepared for use by emptying a given number of doses into the mortar, adding a few drops of boiled and cooled water, and thoroughly grinding. Then

add as many cubic centimeters of boiled water (cooled) as there were doses of vaccine. This is well mixed and filtered in the funnel through loosely packed cotton. The filtered liquid is used for the vaccination.

The injection is made by the hypodermic syringe on the side of the neck or back of the shoulder.

Dose. — The dose is 1 c.c. for yearlings and somewhat smaller for younger animals, down to .5 c.c. for calves.

Proper subjects. — It is not usually necessary to vaccinate calves under six months nor over two years. If calves under six months are vaccinated, they may require re-vaccination next season. Vaccination should be given a few weeks before the disease usually appears, as the disease appears at approximately the same time each year in a neighborhood.

Vaccination should not be given to calves that are weak from disease or ill health, nor at the same time with or soon after any surgical operation like castration. There should be at least an interval of ten days after the latter operation.

Calves that are accustomed to being handled may be vaccinated standing. Those that are wild must usually be thrown or confined in a chute.

Treatment. — Medical treatment for this disease is not considered satisfactory or, as a rule, worth while. Prevention by vaccination is easily applied, inexpensive, and usually satisfactory.

LECTURE XXXIV

FOOT ROT

This is a very old and familiar disease. It is especially prevalent among sheep on soft, wet pastures, but sometimes prevails under conditions of extreme drought. Some outbreaks are infectious. There are other cases which appear similar upon hasty examination, but are evidently not infectious.

General symptoms. — This disease usually affects the feet and produces lameness, perhaps one forefoot at first, between and above the claws. There is a discharge, with very offensive odor, and the hoof itself becomes rotten in places. Loose pieces are detached, and the sole may be affected the same way. The sensitive parts may be exposed in very severe cases, with a development of profuse granulations. The skin above and between the hoofs is red, tender, and swollen. The animal is lame and of course unthrifty. The disease prevails more especially in late summer.

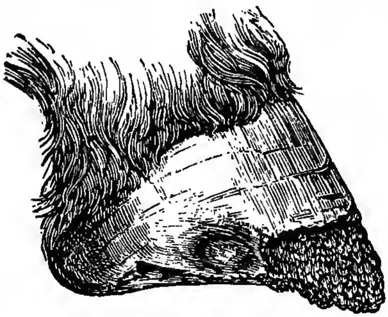

Fig. 53. — Foot Rot of Sheep.
A plain case.

Differential diagnosis. — It is necessary to distinguish between infectious foot rot and a quite different disease which we know as "foot-and-mouth disease." Foot rot begins in the skin between the claws, or above the crown of the foot, and soon involves the sole. It then spreads both as to surface and depth, involving the deeper struc-

tures of the foot. Foot-and-mouth disease begins in an inflammation of the skin between the claws or just above the hoofs. This becomes red, then small vesicles develop which rupture and then dry. Foot rot is a disease especially of horn tissue. In foot-and-mouth disease the whole hoof may loosen at the crown, the inflammation involving especially the skin at the crown and the sensitive parts under the wall and above the sole. In foot rot the horn is diseased and separates in pieces. Foot-and-mouth disease affects several feet and perhaps the mouth and udder also — simultaneously. Foot rot usually affects one foot at first, and there is little or no fever in common cases, whereas in foot-and-mouth disease the fever is characteristic.

Foot rot develops slowly, the animals usually eating fairly well, which is not the case with foot-and-mouth disease.

Foot-and-mouth disease spreads readily to cattle and swine. Foot rot does not so spread.

Simple foot rot. — *Causes:* This is a disease of the horny parts, often due to overgrowth or injury, either one of which may result in a laminitis, and so result seriously for the foot. Similar conditions may account for the development of a considerable number of cases, but this disease does not spread from one animal to another as does the infectious type. Some cases are apparently due to the chafing action of rough, wet, and coarse grasses between the claws. This may be very serious in a few cases, but is not a disease of general importance. Moisture seems to bear an important relation to the development of this type of the disease.

Treatment. — Clean thoroughly between the toes; pare away all diseased horn and remove the loosened pieces. The hoof, if grown out of shape, must be trimmed to normal proportion. Excessive granulations must be cut away or removed by actual cautery, and be repressed by astringent measures or pressure bandages. Pledgets of tow may be dipped in tar and applied over the granulations, so as to bring pressure at the right point. These patients should be

kept upon clean, dry footing, and serious cases should be taken up and kept in the yard or in dry stables. For astringent dressing we may use tincture of iron, varying from full strength to one to four, dissolved in water. Four per cent carbolized tar makes a nice application for cleansing and disinfecting, and keeps out dirt. The medical treatment, particularly the astringent, should be very carefully applied, especially into the crevices and deeper recesses.

Treating whole flock. — It is frequently advisable to treat a whole flock in a general way; in that case the flock may be driven through a large pan containing a solution of copper sulphate about four inches deep; the animals should be forced to remain in the pan for several minutes, so as to insure good treatment. This solution should be made up dissolved in water in the proportion of one to two pounds per gallon of water.

Prevention. — Separate diseased animals from the healthy ones, and bear in mind that either very wet or very dry pastures may be favorable to the development of this disease. Hoofs should be kept pared to reasonable proportions. Cases of foot rot should not be neglected in the earlier and simpler stages, for they are much easier treated then. They may be infectious, and careful treatment and attention may avoid a general outbreak.

FOUL FOOT

Definition. — A disease of cattle somewhat resembling foot rot of sheep and apparently infectious in some outbreaks.

Treatment. — Trim off diseased horn freely. It is sometimes advisable in the early inflammatory stages to poultice with bran or oil meal, using powdered charcoal quite freely in the poultice. For mild cases, white lotion may be used once daily; for more serious cases use 10 per cent creolin in glycerine once a day for two or three days, then reduce to a 5 per cent solution and use every other day for a week or two — as necessary.

It is sometimes advisable to use a roll of oakum soaked in tar, pressed well up between the toes, and held in place by a tar bandage around the foot. In cases where new tissue seems to grow too rapidly, it may be repressed by means of small pads of oakum or tow, soaked with tar and bandaged firmly over the part that needs checking.

For astringent effect upon the granulations, tincture chloride of iron, full strength or diluted to one fourth with water, may be used. Four per cent carbolic acid in tar is very useful, especially as it tends to keep out dirt and foreign matter.

LECTURE XXXV

FOOT-AND-MOUTH DISEASE

Definition. — A very contagious disease, chiefly of ruminant animals and swine. Some outbreaks are much more virulent than others, but an outbreak of this disease is always a serious matter for the owner, even though no animals die, and a very serious matter for the public in general. One attack does not give immunity; on the contrary, this disease is apt to recur at comparatively short intervals.

Symptoms. — The symptoms are here given for cattle. Sheep and swine show in general similar symptoms.

This disease develops in from three to five days after exposure. Affected cattle are first noticed to be sluggish. They shiver, and later on they are stiff and lame. There is profuse flow of the *saliva* with frequent swallowing motions and smacking of the lips. The peculiar lesions of the foot-and-mouth disease are *vesicles* or small blisters affecting the mouth, the skin above and between the hoofs, and over the udder and teats. These vesicles soon break and bleed, leaving raw surfaces which as a rule heal, but sometimes remain as rather chronic ulcers. The skin and superficial tissues around the hoofs become intensely inflamed and swollen. The *stomach* is also involved; affected animals lose weight; and the milk flow is checked. It should be remembered that the symptoms vary greatly in virulence in different animals and different outbreaks. One patient does not usually show all these symptoms. Affected animals are very much inclined to lie down by reason of the sore feet. This disease is not ordinarily fatal, but causes very serious loss in the checked milk flow, and prolonged,

unthrifty condition, and seriously diseased feet. There is a marked fever highest just before the eruption appears. Active symptoms of the disease last from eight to fourteen days, and animals usually recover within about three weeks. The disease of the skin around the hoofs often follows the mouth symptoms, but the two may occur together. When the disease affects sheep and swine, it is apt to involve especially the feet.

Dissemination. — The infecting virus is present in yards, stables, carts, and on the food or feeding utensils. Even a road over which diseased animals may have passed may be infectious. This disease may be disseminated in an indefinite number of ways, and is recognized as one of the most easily scattered of the infectious diseases. The infectious material is apparently present in the discharge from the vesicles, in the saliva, milk, urine, manure, expired air, and perspiration. The infection is probably obtained through the respiratory or digestive organs.

Prevention. — The prevention of this disease is simply the prevention of infection. This country was supposed to be free from this disease until 1902, when it appeared in several of the New England states. Infected premises that have not been disinfected may remain infectious for an undetermined period. Until we have more positive information on this point we may say that it would hardly be safe to risk exposure in less than a year unless the premises can be thoroughly disinfected.

This disease spreads rapidly; it causes heavy losses and is difficult to control after it has become widely scattered. Any reasonable suspicion of its existence should be promptly reported to the local health officer and every possible precaution taken to prevent spread.

Treatment. — Simple cleanliness. Most cases will recover without treatment in two or three weeks, but in some serious cases it is necessary to use astringents and antiseptics, for instance, alum water or creolin. This is especially for raw and inflamed surfaces.

LECTURE XXXVI

GLANDERS

Definition. — The words "glanders" and "farcy" both refer to the same disease, the latter being commonly used for those forms where the skin and external parts are especially affected. This disease is serious because it may be transmitted to human beings and with almost invariably fatal results, and because of great losses among horses. It is easily spread among susceptible animals. Obscure cases may be highly infectious.

Susceptible animals. — This disease is practically confined to horses, donkeys, and mules. Human beings, sheep, and goats are susceptible. Cattle are immune.

Causes. — A minute rod-shaped germ (*Bacillus mallei*), which must be recognized as the direct and specific cause of the disease. Unsanitary conditions and everything which lessens the animal vigor may act as predisposing causes. The disease is more severe and more rapidly fatal among animals which are crowded or overworked.

Incubation. — This period varies greatly. Different authors have given it variously from three to seven days in experimental work. In some cases the period of incubation is probably considerably longer, especially in natural cases.

SYMPTOMS

For our purpose, cases of glanders will be divided into but two classes, viz. glanders and farcy. It is generally customary to distinguish acute and chronic glanders, also acute and chronic farcy, making four types, but acute and

chronic cases of each form differ mainly in severity of symptoms and rapidity of development.

Glanders. — This form of the disease is characterized in general by the development of ulcers on the mucous membrane of the respiratory apparatus; by a peculiar discharge from the nose; and sometimes by chronic cough. Certain glands between the branches of the lower jaw are affected in a peculiar way, becoming enlarged, hardened, and nodular.

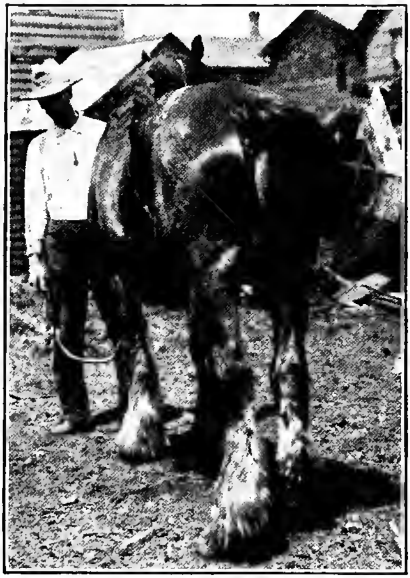

Fig. 54. — Glanders — Farcy. (*M. H. R.*)
A recent case. Note the enlarged leg without farcy buds.

Acute cases. — When the cases are acute, small *tubercles* develop rapidly on this mucous membrane, and soon change to small *ulcers,* which increase in size and even coalesce. Thus is developed the peculiar ulcer of glanders, with its dirty gray base and overhanging edges. The *discharge* from these ulcers is quite distinctly viscid. Very large ulcers and even ragged gutterlike excavations may develop, particularly on the nasal septum. The ulcers may heal, leaving light-colored, more or less star-shaped scars.

The *fever* may be severe in acute glanders, the temperature rising rapidly to 105 or even 107, and then be quite variable for a few days. There may be also persistent *chills.*

There is apt to be a development of V-shaped areas of lung inflammation in the more acute cases. Occasionally there is a partial or apparent recovery from the acute symptoms and then the development of a chronic case.

Chronic cases.—If the disease be chronic, then these same symptoms in general develop less rapidly. The chronic pulmonary form of glanders may be suspected when there is a mild, dry cough, especially if such cough be accompanied by debility and occurs in a stable where an obvious case of glanders has been demonstrated. When the lungs are much affected in chronic cases of pulmonary glanders, the horse is apt to show symptoms of heaves, and on examination post mortem there are found numerous tubercles, usually showing, or easily felt, on the surface of the lungs.

FIG. 55.—GLANDERS—FARCY. (*M. H. R.*)
An old case. Note enlarged leg with old farcy buds, healed.

A horse may be affected with a mild, chronic form of the disease and remain in good flesh, be vigorous and apparently in the best of health for years, showing no marked nasal discharge or farcy sores, and yet be very actively infectious to other horses.

Chronic cases may also show a chronic nasal discharge, nasal ulcers, and nodular, adherent maxillary glands.

Farcy. — In the farcy form of glanders the superficial connective tissues and lymphatics are especially involved.

In the *acute form*, just as with acute glanders, there may be very high temperature with local swellings. This swelling often occurs in one hind leg, with soreness and lameness. As the swelling abates, the characteristic nodules, or so-called farcy buds, appear.

The head may swell badly and later farcy sores appear at

irregular intervals and places. These may heal and leave scars — as shown in Figure 56. When farcy buds break there is discharged a viscid pus that is very characteristic of this disease, being clear and quite cohesive.

FIG. 56. — GLANDERS — FARCY. (*M. H. R.*)
Farcy scars in the face. An old case.

The *specific symptoms* of farcy may be summed up as the *bud*, the *ulcer*, the *lymphatic cord*, and the characteristic viscid sticky *discharge*.

In the chronic forms we have similar histories and symptoms, but the latter may be less obvious and less rapidly developed.

Diagnosis. — A positive diagnosis on the clinical symptoms may be made in many cases, but there are a great many cases which cannot be so diagnosed with certainty. In these cases we must rely upon the mallein test.

Mallein test. — This test may be conducted as follows: Temperatures are taken at 10 A.M., 2 P.M., and 6 P.M. The mallein is then given by hypodermic injection at about 10 P.M. On the following day temperatures are taken every two hours, beginning at 6 A.M. and continuing until 6 or even 8 P.M. A rise of two degrees or more above the normal range is diagnostic and is determined by comparing the temperatures taken on the second day with those taken on the first day of test. Such a rise of temperature is spoken of as a reaction. Reacting animals usually show a prominent and painful swelling at the point of injection. Mallein has developed the rather serious fact that there are unquestionably a great many cases of glanders which are never recognized, some of which are without doubt infectious.

Prevention. — The common methods of spread must be borne in mind, and the fact be clearly realized that the germ which causes glanders is very easily disseminated. Some

of the more common methods of spreading it are by drinking water, feed boxes and troughs, hitching racks and posts, and, in the large cities, by the public water fountains. Any means which serves to bring the virus into direct contact with mucous membranes or with the broken skin may be sufficient to cause an attack. Pus from the farcy sores and the nasal discharge are very virulent.

Prevention consists in avoiding conditions which may bring the virus into contact with the mucous membranes or broken skin. It is never safe to purchase or trade, from a stranger, a horse that has any nasal discharge or suspicious sores. Stories of having caught cold or having a little distemper may usually be suspected, under such circumstances.

Treatment. — It is probable that some cases of glanders recover under favorable conditions without treatment, especially in the Northwest, but this is a very dangerous disease; we have no means of knowing which cases have a reasonable probability of recovery; and medical treatment by the use of drugs has never seemed to give any satisfactory results. For these reasons it is usually conceded by veterinarians that treatment of glanders is not justified. All cases should be reported to the proper health officers.

LECTURE XXXVII

HEMORRHAGIC SEPTICÆMIA OF CATTLE

This disease in the West has been rather commonly and badly named as cornstalk disease. It is interesting because of its many forms; it is interesting because medical treatment so far as we know is absolutely useless and hopeless. We are helpless in the matter of prevention, because we have practically no information as to the method of infection or method of spread. Those who have had a chance to study outbreaks have been quite unable to trace any connection between one outbreak and another, or to trace a previous history for any given outbreak. This disease is worthy of very serious consideration because it is so widespread and so fatal. It appears suddenly and under all sorts of conditions; a number of animals, usually a large proportion, die, and the disease disappears as suddenly as it came.

Etiology. — The specific cause of this disease is apparently a germ, *Bacillus bovisepticus*, very similar to the bacillus of swine plague. How this microörganism spreads or how it gains entrance into the animal body is not known, but at present it is supposed that the entrance may be effected by inoculation, or through the respiratory or the alimentary mucous membrane.

History and development. — The onset is usually sudden and unexpected, and yet in some outbreaks the onset is quite slow and the cases are distinctly chronic.

Season and climatic conditions apparently have nothing to do with the prevalence, virulence, or disappearance of this disease. The mortality is usually high.

Symptoms. — In the writer's experience the temperatures have been often normal or subnormal, except in cases where the temperature rose rapidly just before death.

Local changes which correspond to the tumors of anthrax and symptomatic anthrax are very limited or wanting.

The urine in many cases has been scanty or blood-stained, and this is also true of the bowel discharges.

Examination post mortem. — This is very much more definite and satisfactory. The *blood* is apparently normal.

Fig. 57. — Hemorrhagic Septicæmia. (*M. H. R.*)
Hemorrhages (dark spots) on peritoneal surface of intestine.

Subcutaneous hemorrhages are common and vary greatly in size and intensity; in some cases they are large and the hemorrhagic condition is marked. In other cases the hemorrhages are minute, scattered, and few in number. The hemorrhages may appear almost anywhere in the subcutaneous tissues, or involve any of the internal organs. The *spleen* is not enlarged, but there may be hemorrhages on the surface. The hemorrhages usually have sharply defined borders and are easily recognized as hemorrhages.

The *serous membranes* frequently show small hemorrhagic areas, and the *heart*, especially its auricles, is often intensely hemorrhagic.

Summary. — We may summarize the symptoms as follows: In acute cases the disease appears suddenly; the case develops very rapidly and terminates fatally. The ante-mortem symptoms are very unsatisfactory from a diagnostic standpoint. The post-mortem symptoms are definite and as a rule easily recognized, and consist of more or less extensive hemorrhages which are sharply defined when they appear upon the surfaces of the viscera and serous membranes.

MENINGEAL TYPE

History. — Cows which have given a normal flow of milk in the morning may give practically none in the evening. Otherwise they are apparently normal. They may be slightly ailing the next morning, but showing little aside from dullness. There may be no rise of temperature; no evidence of pain or discomfort. When they attempt to walk, the gait is more or less irregular, resembling very much the gait of milk fever in its early stage. This is of course more marked in some than in others.

Fig. 58. — Hemorrhagic Septicæmia. (*M. H. R.*)
Hemorrhages on endocardium (internal lining of the heart).

Symptoms. — The symptoms[1] during the first 24 to 36 hours are not marked, except as to continued dullness, staggering gait, and cold extremities. The skin is harsh and lacking in sensation.

[1] In case of young calves, the cases may be characterized by profound nervous disturbance very early in their histories.

This loss of skin sensation begins at the posterior extremities and gradually extends forward. The milk flow is checked.

After 24 to 36 hours, diarrhea appears, the discharges being dark and thin with very disagreeable odor. Nervous symptoms gradually develop and are quite uniform.

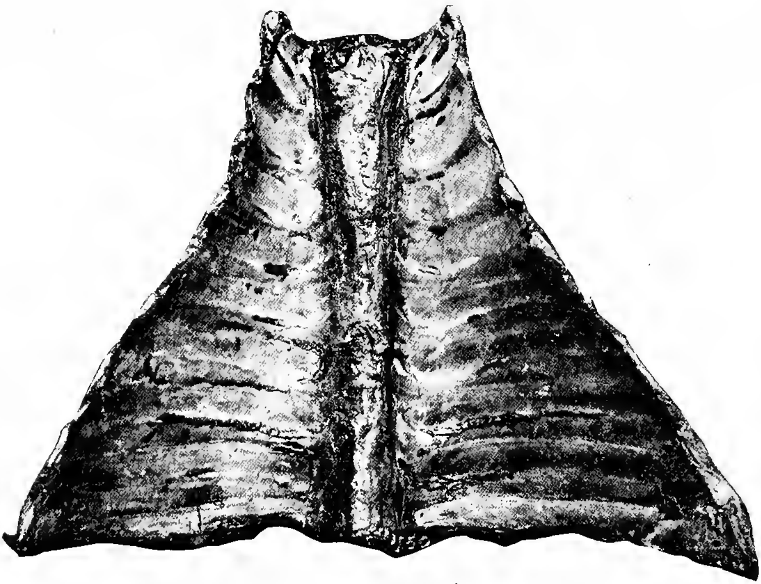

Fig. 59.—Hemorrhagic Septicæmia. (*M. H. R.*)
Hemorrhages on costal pleura.

The symptoms during this second period are those which belong to a gradually developing cerebro-spinal meningitis. The inability to walk naturally is continued, the gait being irregular and weak. The neck is often bent to one side, and the muscles, particularly of the face and neck, spasmodically contracted. During this period the animals are still quiet, moving around very little; but the eyes show a wild, unnatural expression. During this period the animals may commence to chew in a nervous and very persistent manner, with more or less profuse flow of saliva. The temperatures may remain normal or subnormal.

Later, there appears a third fairly distinct period of intense nervous activity. The eyes continue to grow more wild and unnatural; the grinding of the jaws more active and more constant; the convulsions of face and neck muscles become more intense; then gradually a period of intense restlessness and activity, and death ends the scene.

Post-mortem symptoms. — Meningitis involving the spinal cord or brain or both is plainly evident. In addition to this

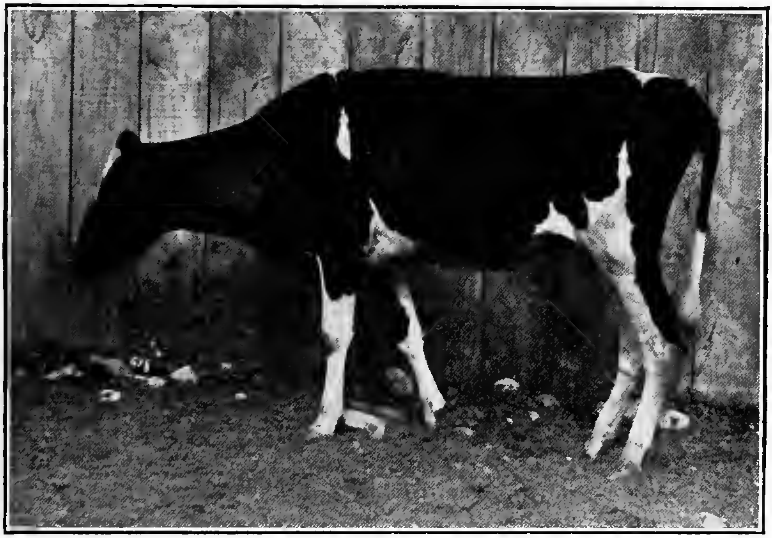

Fig. 60. — Hemorrhagic Septicæmia. (*M. H. R.*)
Meningeal type. Cow stupid. Early stage.

there are hemorrhages involving the subcutaneous tissues, and lymphatic glands in various portions of the body; also involving the pleuræ, pericardium, and surface of various internal organs, as in the usual type of the disease.

A peculiar fact which appears in connection with these meningeal type cases is that the animals which are apparently most seriously sick early in their histories are often the cases which live longest, whereas the apparently milder cases die very quickly and very unexpectedly.

DIFFERENTIAL DIAGNOSIS

It is very important to distinguish between blackleg and hemorrhagic septicæmia, because, so far as our present knowledge extends, we are helpless in the presence of hemorrhagic septicæmia. We have no vaccine either preventive or curative, and no medical treatment; whereas blackleg can be easily and cheaply prevented by vaccination.

In both diseases, death is liable to occur very suddenly, but blackleg commonly affects only cattle under two years of age, whereas hemorrhagic septicæmia affects all ages indiscriminately. High temperatures are characteristic of blackleg, especially early in the history of the cases, whereas, in hemorrhagic septicæmia, the temperature is often normal or subnormal until near death, and then in some cases rises very rapidly. A pronounced swelling of the front or hind quarter is rather characteristic of blackleg, although in some cases which die very suddenly there may be no noticeable swelling. These cases usually occur early in the history of the outbreak of blackleg, and following them there are other cases which show the characteristic swellings of blackleg. Swellings of this kind are not characteristic of hemorrhagic septicæmia, and when present at all are small.

Blood taken from a blackleg tumor is dark, frothy, and with peculiar odor, whereas blood taken from a case of hemorrhagic septicæmia is apparently normal. It should be noted that this is also true of blood taken from general circulation in the cases of blackleg.

A diagnosis between these two diseases may, as a rule, be quite easily made by examination post mortem. Here we have in a case of hemorrhagic septicæmia the characteristic hemorrhages which appear as blood-stained or bruise-like areas under the skin; and sharply defined blood-stained spots on the internal organs or the lining membranes of the chest and abdomen. These hemorrhages are not at all characteristic of blackleg. On skinning animals affected with blackleg, crepitating, gas-filled tumors of blackleg are usually found, which are characteristic of that disease. These are not found in hemorrhagic septicæmia.

A Comparative Study of Hemorrhagic Septicæmia, Anthrax, Symptomatic Anthrax (Blackleg) and Cerebrospinal Meningitis.

	Hæmorrhagic Septicæmia	Anthrax	Symptomatic Anthrax (Blackleg)	Cerebrospinal Meningitis	Remarks
Cause	*Bacillus bovisepticus.*	*Bacillus anthracis.*	*Bacillus chauvoei.*	*Diplococcus intercellularis. Diplococcus pneumoniæ.*	
How spread	Unknown.	Any infected object.	Food, water, carcasses, discharges, etc.	Uncertain, probably foodstuffs.	
Extent of spread (single outbreak)	Localized.	*Widespread.*	Local.	Local.	
Infection	Unknown.	Digestive organs, respiratory organs, and inoculation.	*Inoculation.*	Probably digestive organs and possibly respiratory organs.	
Season favoring	Indifferent.	Hot, dry summer, following wet spring.	Summer and fall.	No information.	
Susceptible animals	Very general.	Very general.*	Young cattle, sheep and goat.	Cattle, horses, sheep, goat and dog.	* Swine but slightly susceptible.
Mortality, per cent	80–90.	80–100.	80–100.	80–90.	
Symptoms.					
Onset	Sudden in acute, slow in chronic.	Sudden.	Sudden.	Usually sudden.	
Local swellings	Slight or absent.	Rare in acute cases,* *no subcutaneous emphysema.*	Usually marked and *emphysematous.*	Absent.	* May be present in other cases.
Urine	Sometimes blood-stained.	Frequently blood-stained or dark.	Sometimes blood-stained or dark.	Normal appearance.	
Feces	Frequently blood-stained.	Frequently blood-stained.	Constipation, intestinal contents bloody.		
Autopsy.					
Blood (general circulation)	Normal appearance and coagulation.	*Dark or muddy, feeble coagulation, doesn't red'n in air.*	Normal color and coagulation.*	Usually normal appearance and coagulation.	* *From tumor, dark, frothy, and fetid.*
Hemorrhages	Usually present, general, clearly defined.*	General, nearly all organs.	Not general, may occur in heart, lungs, and subcutaneous tissues.	Reported, but diagnosis is questioned.	* Vary greatly in size and intensity.
Serous cavities	*Hemorrhages frequent.*	Reddish serum usually present.	Serum may be present, especially in abdominal.	May contain serum.	
Spleen	Normal, except superficial hemorrhages.	*Enlarged, dark, soft.*	Normal.	Normal.	
Subcutaneous gas (soon after death)	Not present.	Not present.*	*Present before and after death.*	Not present.	* General decomposition rapid.

LECTURE XXXVIII

HOG CHOLERA

Definition.—The term "hog cholera" should obviously be limited, and refer to a single specific disease which can be clearly described. To be considered hog cholera the disease should be recognized as an infectious disease for swine. It must be infectious by pen exposure, and an attack followed by recovery must give immunity. The blood from a diseased hog should be virulent and capable of reproducing the disease, the living animal should show the symptoms later described, and the carcass of the dead animal should show the symptoms as given under autopsy.

Variations in virulence. — Outbreaks of hog cholera vary greatly in virulence. In some epidemics the virulence is marked, and the hogs die quickly; in other epidemics the majority of the cases assume the chronic type; the hogs do not die so quickly, and the percentage of loss is not so great.

Various gradations may appear between epidemics of the utmost virulence and those of the milder type.

Swill-barrel cholera. — The fact must not be lost sight of, in this connection, that outbreaks of swine disease appear and alarm neighborhoods when the trouble is due to local causes. They are usually diseases of the digestive apparatus, and due to errors in feeding. This trouble is sometimes due to filthy swill undergoing bacterial changes in dirty barrels. Sometimes it is due to strong alkali soaps in swill. All the patients become diseased from the same source and in the same way, but the disease does not spread. Several neighbors may make the same mistake at the same time and get similarly bad results.

Early symptoms. — When this disease appears the hair becomes harsh and dry, the eyes may be watery, and locomotion becomes weak and irregular, with imperfect control of the hind legs. The skin around the flanks and fore legs and abdomen may become purple; the skin of the ears frequently becomes much inflamed, and, if the hog lives for several days, may assume a scabby appearance. Sometimes the tips of the ears slough off. The sick hogs separate themselves from the rest of the herd, are disposed to hide

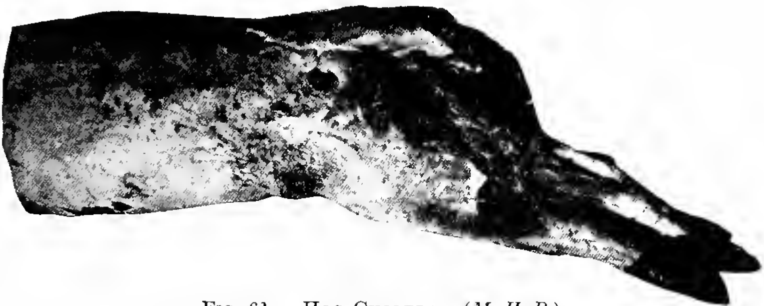

Fig. 61.—Hog Cholera. (*M. H. R.*)
Subcutaneous hemorrhages resembling those of hemorrhagic septicæmia. Note the dark spots.

in sheltered places, and seem but little inclined to move about. There is usually a loss of appetite, although in some very acute cases the appetite may remain good until the end. Chronic cases lose flesh rapidly, and sometimes show extreme disturbance of the nervous system, exhibited in partial or complete paralysis of the hind parts, or extreme nervousness. The cough is usually short and hacking. Occasionally constipation appears among the earliest symptoms, but is usually not noticed; later diarrhea appears. In some of the very acute cases which appear at the beginning of an outbreak the animals die very suddenly— sometimes before the owner realizes that they are sick. Later in the history of the disease, as it appears in a herd, the cases tend to assume a more chronic type.

Sometimes quite large portions of skin and underlying muscular tissue die and slough off, leaving large sores. This

appears more commonly, perhaps, around the neck, head, and back than elsewhere.

Autopsy. — The skin on exposed parts of the body where the hair is thin, like the flanks and inside of the fore legs and thighs, may be deep red or purple. Blood-stained spots may be usually found in the fatty tissue under the skin and on the internal organs. The lungs may show evidences of pneumonia. The lymphatic glands in the mesentery and elsewhere appear deeply congested or inflamed.

Fig. 62.—Hog Cholera. (*M. H. R.*)
Hemorrhages (dark spots) on diaphragm. Hemorrhages are characteristic.

When the large intestine is split open, dark spots, more or less blood-stained, or even clots of blood, are to be seen upon the lining membrane when the disease has been of the very acute type. The more chronic cases show peculiar and very characteristic ulcers in the lining membrane of the large intestine, and they are usually more numerous near the cæcum or blind pouch. These ulcers are irregular in outline, with yellowish or dark centers, and frequently appear as being raised above the surface. Small ulcers may also be seen in the back part of the mouth and in the throat.

The spleen is frequently enlarged, and darker in color than natural. Small bright red spots are found on the surface or through the deeper structure of the kidneys.

In some cases the lung lesions are most prominent. The skin may show the same purple spots and areas as in hog cholera. The lungs show scattered and sharply defined areas, which are dark red in color, and solid, like liver. The lining membrane of the chest may be diseased; but it is not uniformly so, and, when this occurs, it usually follows disease of the lung tissue.

The cause. — We must not forget that hog cholera is an infectious disease, and that it has its prime origin in a living germ. This germ is probably so small as to be invisible with our best microscopes and capable of passing through a laboratory germ filter. Simple conditions of keep and feed have much to do with making the animals

FIG. 63. — HOG CHOLERA. (*M. H. R.*)

Large intestine; mucous membrane showing general distribution of typical ulcers. I, Ileum; C, caecum or blind pouch.

susceptible, but mere matters of food and surroundings cannot serve as first cause of hog cholera. The predisposing factors in the causation of this disease must be given due consideration, but the most important thing to remember is that it is due to a living germ, that it never appears without infection, and that this germ may be carried from one place to another. If the hog is fed exclusively on corn diet, or from a swill barrel that has been used for years and never scalded or allowed to dry in the sun; if it is kept shut up in dark, damp, and perhaps filthy pens, it will not be able to

resist any disease as would one kept under more favorable conditions.

It is evident to all who have given the subject careful attention that swine hygiene should receive far more attention in the future than it has had in the past, and that here there is a large field for scientific study. Good digestion aids in the destruction of bacteria in the food, while congestion or catarrhal inflammation of the mucous membrane of stomach may result in a smaller percentage of acid in the gastric juice, and thus the germ-destroying power of this fluid be diminished. Tissue vitality must be regarded as a very important factor in increasing the disease-resisting power of any animal. The laws of hygiene cannot be neglected without rendering animals more susceptible to disease.

How scattered. — The germs of this disease may be carried from place to place in any way that fine particles of dust may be carried, *e.g.* upon shoes, or by wagons, or by driving stock back and forth over an infected area; or they may be scattered by driving or transporting infected hogs along the public highways. Dogs are frequent carriers of this disease. Running streams and shallow lakes are also serious factors in the spread of the germs. Bowel discharges are very important sources of infection, and, if the yards or pens drain into streams or lakes, these become carriers of the infection. Hogs that have died of hog cholera are sometimes thrown into streams or buried in the sand near the edge of a stream or lake, thus infecting the water.

Hog cholera germs may live three months, and possibly longer under favorable conditions. They are apparently hardy and difficult to destroy.

When an outbreak appears. — In case there is a suspicious disease among hogs in a neighborhood, the matter should be reported promptly to health officers, and this first outbreak should be rigidly quarantined.

But one man should have the care of a herd of healthy hogs, and this man should not be allowed to go where there

is a possibility of getting the infection. Neither the owner nor any member of his family should go to any farm where an infectious swine disease has appeared; nor should any one from the farm where such sickness is present be allowed to walk about the yards of his neighbors.

Dogs and other dangerous visitors should be kept away from the pens on uninfected farms by a temporary fence of woven wire.

Before a herd becomes infected, it may be desirable to divide it into three or four parts, and separate these groups widely on different portions of the farm. The owner may then lose one group, or even two groups, and still save the others, should the disease come his way.

If hog cholera appears in a herd during the summer or fall when the weather is pleasant, it may be desirable to turn the hogs out into a large yard or field rather than to keep them closely confined in pens or stables, where the danger from infection is greatly increased. Larger or smaller doses of infection have much to do with determining the fatality of the disease. If hogs are allowed to run in yards or fields, each hog is exposed to the smallest possible amount of infection. Hogs should not be allowed access to small ponds or mudholes during the prevalence of any suspicious disease among them. Such ponds and mudholes become deadly centers of infection.

If the weather is cool or wet, the herd should be given quarters as warm and dry as possible, for with hogs turned out to shift for themselves, under such conditions of exposure, the mortality is apt to be very high.

It is apparently useless to spend money on medicines in the treatment of this disease. Before giving credit to patent medicines, one should bear in mind that outbreaks often check suddenly without any treatment.

Experience demonstrates that it is desirable to separate the well from the sick animals promptly, and to place the well in uninfected sheds, pens, or yards. It is also desirable to keep the pens, both where the sick and the healthy hogs

are confined, thoroughly cleaned and frequently disinfected. For this purpose, unslaked lime is quite satisfactory, and it is easily applied, as are the better grades of coal-tar disinfectants.

Hog cholera vaccination. — A new vaccination known as the Dorset-Niles method is rapidly becoming available; the serum being produced by a number of agricultural experiment stations and sanitary boards. The method of producing this serum is in general as follows:

A hog that is immune by reason of having passed through the disease or which has been vaccinated is given inoculation of a very large quantity of virulent hog cholera blood. After a time his own blood develops property which protects other hogs when injected under the skin or into muscles. This immunizing serum alone produces a prompt but temporary immunity, but if a hog so treated be given pen exposure with sick hogs, or be given an injection with a small quantity of virulent blood (simultaneous vaccination), it then becomes permanently immune. In this case it is on practically the same basis as an animal that has had the natural disease in an outbreak and recovered. There are therefore two methods of doing this vaccinating: Serum only, which gives prompt, but temporary immunity, and simultaneous vaccination, which gives permanent immunity. The dose of serum varies according to the weight of the hog treated. It is important that the serum should be kept unopened and cool until used, and that all precautions are taken to insure clean work in vaccinating.

There are two very useful fields for this vaccine: One where owners wish to vaccinate valuable hogs in advance of any possible outbreak, or, for example, when going to stock shows. The other and perhaps the most important is in connection with outbreaks of the disease where vaccine can be used to lessen the loss if used early in the outbreak and protect surrounding herds and check the outbreak.

Common mistakes. — It is a mistake to *bury* hogs that have died of hog cholera when the carcasses can be burned,

for burning is by far the most efficient means of destroying the germs of such diseases. If it is not convenient to burn the carcasses, they should be buried under at least four feet of earth.

It is a mistake, and frequently a serious one, for a farmer to ship in a lot of strange hogs from unknown stockyards, in cars that may have been infected, and to put these with

Fig. 64.—Hog Cholera. (*M. H. R.*)
Ulcers in mucous membrane of large colon. Bowel split open. View of the interior.

stock hogs already on hand. The mere fact that the hogs came from an uninfected district is no argument to the contrary, for the car in which they were shipped may have recently carried a lot of hog cholera victims. Strange hogs should be quarantined for three weeks before putting them with hogs already on the place. This gives time for the disease to appear in case the new hogs have come from infected herds, or through infected stockyards, or in infected cars.

It is a mistake to visit your neighbor's hogpens, and walk about among the hogs out of mere curiosity, when your neighbor has told you that some peculiar sickness has appeared in his herd.

It is a mistake to allow the last one or two sick hogs, which usually show a very chronic type of the disease, to linger for months on the farm. It is a better policy to kill such hogs promptly, and have done with the disease. They do not usually become thrifty and profitable feeders for a long time after recovery. On the other hand, they may

remain infectious to the last period of their sickness, thus keeping the yards and pens infected and furnishing a constant supply of infectious material for fresh outbreaks; whereas, if they had been killed, the infectious material would soon have been destroyed.

It is a criminal mistake to throw carcasses into any stream, lake, or pond, or to bury them near such body of water.

Suggestion. — It is a very simple matter to quarantine an outbreak of hog cholera when it first appears, and it is extremely difficult to quarantine the disease after it has been scattered over several townships. Quarantine must be rigid to be useful. Partial or imperfect quarantine is worse than useless.

Disinfection. — If the disease be genuine hog cholera, it is not easily controlled, for the germs may live three and perhaps four months, under favorable conditions, in the soil and about the buildings. Sometimes the cheapest way to disinfect is to burn the old sheds and pens where the hogs have been confined. But if these structures are valuable, the matter of other means of disinfection is to be considered. In this case, corrosive sublimate, dissolved in water in the proportion of 7.5 grains to each pint, is a good disinfectant; or whitewash that is made by using water that contains four per cent of pure carbolic acid may be used instead of the corrosive sublimate solution. All bedding and loose stuff should be burned. The ground may be disinfected by saturating the surface with corrosive sublimate solution, or by burning off straw that has been scattered over the surface, or the danger from infection may be lessened by plowing the infected area. Sometimes it is more desirable to destroy the floors of pens than to attempt to disinfect them, but if it is thought desirable to disinfect, they should be thoroughly saturated with the 1:1000 corrosive sublimate solution, or with boiling water.

LECTURE XXXIX

TEXAS OR TICK FEVER [1]

Economic importance. — The seriousness of tick fever as a disease of cattle and the bearing of this disease upon the southern cattle industry was not realized until within a few years. To-day we know that it is responsible for the death of more cattle throughout the southern states than any other half dozen diseases. Even at this time its true nature is not generally recognized by the stockmen.

Names. — This disease passes under a variety of names, such as acclimation fever, red water, bloody murrain, distemper, town-cow disease, hollow horn, hollow tail, etc.

Causes. — It has been established that the disease is caused by an animal parasite, a protozoan, which attacks the red corpuscles of the blood. Little or nothing is known of the life history of this parasite outside of the blood of the affected animal. Its multiplication in the blood is very rapid and its effects are very destructive, involving especially the red blood corpuscles. It destroys these very rapidly.

Transmission. — So far as known the only natural means of transmitting the germ of this disease is the southern cattle tick (*Boophilus annulatus*).[2] Other species of ticks attack southern cattle, but this is the most common and is the only one responsible for the transmission of the Texas Fever germ.

The ticks do not carry the germs direct from one infected animal to another, but the female ticks develop on infected

[1] **This lecture contributed by Dr. Tait Butler.**

[2] Or *B—Bovis* (Riley).

animals and then transmit the germs to their progeny, and the young ticks carry the germs to susceptible animals, which they may chance to infest.

Susceptibility. — Bovines alone seem susceptible to the disease, although the tick, which carries the infection, occasionally infests horses and mules. Calves at birth are as a rule immune; but this immunity is gradually lost until at two years of age nearly all are highly susceptible to the disease. Cattle reared in the southern states on tick-free pastures are as susceptible as those raised in the North.

Period of incubation. — The disease usually develops in from seven to ten days after direct inoculation of a susceptible animal with the blood of one infected, or that has acquired immunity from a previous attack. When infection occurs in the natural way, about the same time usually elapses between exposure to tick infestation and the development of the disease. This period is not always uniform, or in some cases no evidences of the disease can be detected before fifteen to thirty days after inoculation. However, a large percentage of cases develop within ten days after inoculation.

Symptoms. — It is frequently stated that tick fever occurs in acute and chronic forms. The chronic form, however, usually follows the acute, and appears months after the acute attack. These relapses or secondary attacks are not uncommon in the late fall and early winter. It is then difficult to distinguish them from ordinary debility from other causes except by the history of a previous attack or by an examination of the blood.

Fever. — In the acute type of the disease an elevation of temperature is usually the first noticeable symptom. A temperature of 107 degrees or 108 degrees F. is not unusual, but when it reaches 105 degrees or 106 degrees, other symptoms usually become apparent. While there are considerable fluctuations in temperature, it generally remains high during five to seven days and may then drop suddenly to normal or below. Many animals die during the extremely

high temperature, or, if the temperature, falls, it is only as a prelude to death. The period of subnormal temperature is a dangerous one, and collapse should be fortified against. Otherwise an animal may succumb that might by proper treatment be saved.

Other symptoms. — The patient usually stands apart with the head down and back arched. In severe cases, or when death approaches, it may lie or fall down. The pulse usually runs from 80 to 100, and the respirations from 50 to 60 per minute. In most cases during the extremely high temperatures, the urine is highly colored, sometimes becoming of port wine color or almost black. The red color is merely coloring matter from the red corpuscles, which are rapidly destroyed by the germs. At first the bowels are constipated, but later diarrhea is not uncommon. The mucous membranes are usually pale and sometimes slightly yellow. As death approaches and the symptoms become aggravated, the animal usually remains down. Occasional periods of excitement, or even convulsions, may occur.

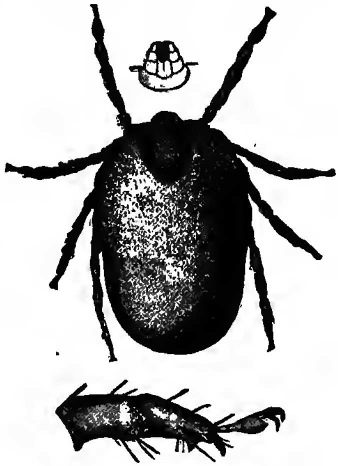

FIG. 65. — TEXAS FEVER TICK. (*Pettit.*)
Female engorged. *Boophilus bovis* (Riley).

History of the case. — The most important factor in determining the diagnosis, next to finding the germs in the blood, is the history of the animal and the presence of ticks. If the animal has not previously been exposed to tick infestation and has recently changed location, or if tick infestation has in any way been rendered possible, a searching examination should be made to ascertain whether ticks are really on its body.

Ticks, where found. — The ticks are most likely to be

found on the tender parts of the skin, such as between the hind legs, on the escutcheon, on the inside of the elbows, or on the brisket, which is most exposed. Since the disease may develop within ten days after ticks attack the animal, and this time is not sufficient for them to become larger than twice the size of a pinhead, it will be readily appreciated that to find the ticks is not always an easy matter, especially if they are not numerous. Other diseases producing blood-colored urine are extremely rare among cattle in this country.

Conclusion. — The presence of the symptoms described may therefore be considered as diagnostic, and good evidence as to the presence of ticks, even though these may not be found.

Post-mortem appearances. — Only in animals that die during an acute attack are the changes well marked, and of those only the more pronounced will be given. Other changes may be seen, but they are often only slight, or absent.

The *subcutaneous tissue* may be slightly yellow and infiltrated with yellow-colored serum.

The *muscular tissue* is frequently pale and flabby, especially in chronic cases.

The *spleen*, in cases that succumb during the height of or just after the subsidence of the fever, is much enlarged and dark colored. When held up by one end, the contents of the capsule will tend to gravitate to the lower end. When cut into it is black, soft, and engorged with blood.

The *liver* is enlarged, congested, and usually mottled in color, due to bile-injection. The bile is increased in quantity, dark colored, thick and ropy, sometimes almost semi-solid.

The *kidneys* are usually engorged and dark, and the bladder contains urine varying in color from slightly red to almost black.

Prognosis. — The death rate in calves under six months old is extremely low. In cattle a year old it may range

from ten to twenty-five per cent. In those two years old it will probably be from twenty-five to fifty per cent, and in those over two years old from fifty to eighty per cent.

Treatment. — This usually proves unsatisfactory. The results scarcely justify the expense and trouble which it entails, except in very valuable animals. During the first stages, when constipation is present, a purgative consisting of from one to one and one half pounds of Epsom salts and one dram of calomel may be given. This should be followed by two to three ounces of hyposulphite of soda and from one to four drams of quinine three times a day. When the temperature drops to normal, or below, stimulants should be used freely for a short time and be followed by iron and strychnine until convalescence is established.

When the first case appears in a herd, all other animals that have been similarly exposed to tick infestation should be removed from further danger of such exposure, and thoroughly greased. Any cheap oil will do, but if it be one third kerosene, it will be more effective. This will not only kill the ticks already on the animal, but prevent others attacking it. An outbreak can usually be cut short in this way and the losses reduced very considerably.

Prevention. — Immunity to tick fever in mature animals, so far as we now know, can only be secured through an attack of the disease. Cattle raised on tick-infested pastures have been rendered immune by mild attacks of the disease before they became fully susceptible. If it is true that immunity can only be secured through an attack of the disease, it follows of necessity that the only preventive is the exclusion or extermination of the tick.

The ticks on any pasture or farm may be easily and quickly exterminated and the farm easily maintained free from ticks. Hence, it is possible, if not yet practicable, to exterminate the ticks over the entire South and maintain the country tick-free.

METHODS BY WHICH TICKS MAY BE EXTERMINATED

1. Keep all cattle, mules, and horses out of the tick-infested pasture, lanes, and lots for one season, or, at least, after September 1, and the ticks will be exterminated by the next spring.

2. Divide the pasture by a fence, with a rail or board tight on the ground, and keep all cattle, mules, and horses out of one half this year after September 1, and out of the other half next year, and the work of exterminating the ticks will have been accomplished.

3. If possible burn the pasture over thoroughly in the spring. Mix sulphur with the salt given the cattle — one part of sulphur to three of salt. Begin not later than April 15, and grease the legs and under parts of the body of all cattle, once a week, all summer. In greasing look carefully for any ticks that may have escaped the grease or attached themselves to the upper parts of the body. If any are found, pick them off and burn. The grease should be one third kerosene and the other two thirds any cheap oil available. If a little sulphur and tar be added, the effect may be improved.

This third method requires considerable care and thorough, regular work to make it effectual, and is only practicable when the number of cattle is not too large.

Concerning the life history. — The methods just given are based on the following facts concerning the life history of the tick: the full-grown female tick drops off the cattle when she becomes engorged with blood. Her heavy body and small, short legs make crawling difficult, so she gets under the dry grass, or "trash" close at hand. In two or three days she begins laying eggs, and lays from 1500 to 2500 during the next two weeks. In very warm weather, under the most favorable conditions, these eggs hatch in about three weeks. The period may be prolonged for eight weeks, or indeed, the hatching prevented entirely, if the weather is sufficiently cold.

The young ticks when first hatched are very small, being scarcely visible. They crawl up the grass, weeds, or small twigs, and there wait for the cattle to come along. If the cow does not come along for three months, they will still be there waiting for her. If no cow, mule, or horse comes along in three or four months, these small ticks die from starvation, for they have no other known means of obtaining food for development. If the young tick succeeds in lodging upon the skin of a cow, then in three or four weeks (and in cold weather much longer) they reach their full growth. The females, being engorged with blood, drop off and begin laying eggs as did their mothers.

Neither old nor young ticks crawl far, hence a fence with a bottom rail or board on the ground will stop them, but wire fences do not always afford protection.

Ticks do not crawl from one animal to another.

Eggs laid during the cold weather of late fall and early winter do not hatch, hence go through the winter as eggs and hatch when warm weather comes in the spring.

All eggs laid before September 1 will probably hatch the same fall, and, therefore, the young ticks will be killed by the cold winter weather or starve to death before spring.

Inoculation. — Not only does tick fever kill hundreds of thousands of dollars worth of Southern cattle every year and depreciate the value of all those marketed from one fourth to one half cent per pound live weight, but it also offers the greatest existing barrier to the improvement of the quality of Southern cattle by rendering the importation of pure-bred animals for breeding purposes extra hazardous and expensive.

For the purpose of conferring immunity on imported pure-bred or other cattle, a method of inoculation has been found practicable which reduces the loss from fifty per cent or more to ten per cent or less.

Method. — The process consists in drawing from 1 c.c. to 2 c.c. of blood from the jugular vein of an animal not less than two years old that was infested with ticks the

preceding summer, and injecting it immediately under the skin of the animal to be inoculated. This will produce tick fever in from seven to ten days. From this not more than one to three per cent will die if the subjects have been selected with proper care and are judiciously handled.

Important conditions. — The animals should be between nine and fifteen months old.

The inoculating should be done during December, January, or February, for tick fever is less severe in cold weather.

All ticks should be kept off the inoculated cattle until they have fully recovered from the inoculation fever.

The inoculated cattle should at first be protected from gross tick infestation by having their legs and under parts of their bodies greased.

The inoculated animal should be infested with the first crop of ticks appearing in the spring, for these are probably less virulent than those hatched in the fall, and therefore produce a type of disease intermediate in severity between the inoculation fever and that caused by the fall ticks.

If these precautions are taken, not more than three to five per cent will die from tick infestation after inoculation.

In the opinion of the writer the best method of introducing pure-bred animals for improvement of the native stock is to import calves under four months old and allow them to become immunized by tick infestation, as occurs with our native-born stock.

LECTURE XL

TUBERCULOSIS

IMPORTANCE of this question is evidenced by the fact that human consumption and bovine consumption are apparently forms of the same disease, and this disease may probably be transmitted from cattle to people. It is unquestionably the most serious question now confronting the medical profession.

Prevalence. — The most widespread and universal disease affecting either humanity or domestic animals. This is shown by reports coming from all parts of America and the civilized world. This disease prevails among all of the domestic animals, excepting possibly sheep. Concerning the susceptibility of these animals there is some discussion. Prevalence is probably greatest in the various classes of animals in the order named: cattle, hogs, horses. Chickens are also quite susceptible.

A careful study of prevalence according to class and condition has shown just what any student of sanitary conditions should expect. The percentage was highest in each comparison among "pure breds," in "city dairies," in "poor condition of stables," and "poor ventilation"; but it was shown that farm conditions, good stables, and good ventilation did not prevent infection. The percentage in pure-bred herds is much higher than among grades or natives. These records must not be taken to indicate that farmers should not improve their stock or that pure-bred herds should not be maintained. The evident suggestion is rather that it is unwise to attempt improving a herd by tuberculosis stock or to found a herd upon such stock.

Cause. — No fact in medicine is better established than that tuberculosis is caused by the bacillus of tuberculosis. We cannot have tuberculosis without these germs, and it is probable that no domestic animals or man can be placed under continued exposure to the germs without ultimately having the disease. Certain predisposing conditions undoubtedly have much to do with the development of this

Fig. 66.—Bovine Tuberculosis. (*M. H. R.*)
A case showing plain symptoms of disease. Rare type.

disease; for instance, close confinement, lack of ventilation and sunshine, and injudicious inbreeding.

Modes of entrance. — (1) Lungs, with inhaled air; (2) stomach and intestines, with food and drink; (3) by inoculation through broken skin or mucous membrane; (4) by infection *in utero, i.e.* before birth. This (4) is very rare and probably of small importance compared with the others.

Structures affected. — Tuberculosis may affect almost any tissue or organ of the body. Milk from tuberculous cows may be tuberculous, but the danger is especially great when the udders are affected.

Extent of tissue diseased may vary from a few small lymphatic glands to a general invasion of lungs, liver, kidneys, mesenteric glands, peritoneum, and pleura.

Symptoms. — These vary according to extent and location of the disease. A few cases become thin and rough in appearance, and have chronic cough or chronic diarrhea, and show that they are in a debilitated condition. The great majority of these cases show no symptoms, but on the

FIG. 67. — BOVINE TUBERCULOSIS. (*M. H. R.*)

A famous show steer, in prime "condition." Liable to be as badly disessed as the preceding.

contrary appear to be in the finest physical condition. There are a great many mild or latent cases, having but a small amount of tissue diseased, and the animals may live for many years. They may possibly die at old age, but on the other hand they may succumb to a sudden development of the disease following any condition which produces debility.

When the *lungs* are involved, there may be a persistent cough, shortness of breath, pallor of visible mucous membranes, loss of flesh, and unusual sounds in the lungs.

When *intestines* and mesenteric glands are affected, there may be chronic diarrhea with slow and persistent loss of condition. All these diagnostic symptoms may vary greatly and are often unreliable; *e.g.* a cow may be in good flesh, hair and eyes bright, and yet ready to die in a short time.

Diagnosis. — The only reliable test is tuberculin, or Koch's lymph, which seems to be very accurate. An aver-

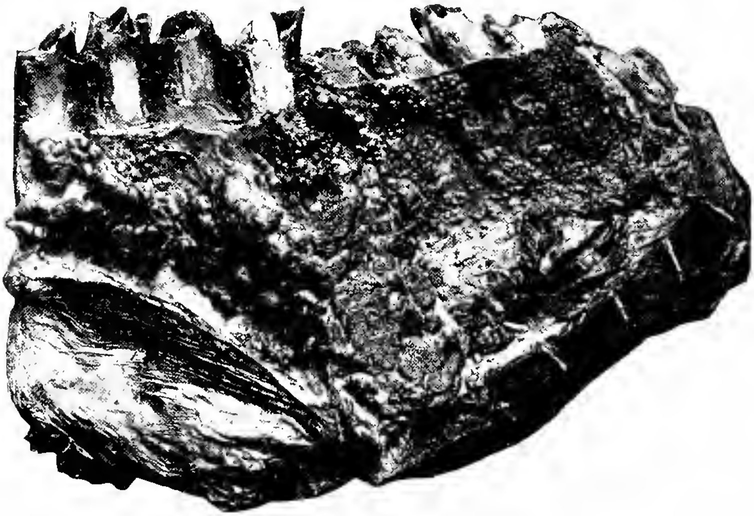

FIG. 68. — BOVINE TUBERCULOSIS. (*M. H. R.*)

A great variety of tubercles on the chest lining (costal pleura). Sternum below, broken ribs above.

age of tests and post mortems of reported cases shows an accuracy of about 96 per cent. Tuberculin is used by injecting a definite quantity under the skin with a hypodermic syringe. Temperature is taken before and after the injection. A pronounced rise of temperature (2 degrees F., or more) ordinarily shows the presence of tuberculosis.

Treatment is not practical. It is usually advisable to destroy or isolate diseased animals at once.

Prevention. — Stockmen should breed with a view to increasing physical vigor instead of breeding fit subjects for tuberculosis, as many are doing. Bear in mind that an

animal may give a fine physical appearance and yet be easily susceptible to disease or be actually diseased.

The practice of keeping cattle almost continuously in the stable does not harmonize with plain teachings of physiology, and the results of this practice must sooner or later be disastrous. The great law of animal life, that use begets strength and idleness begets disease, applies to lungs as

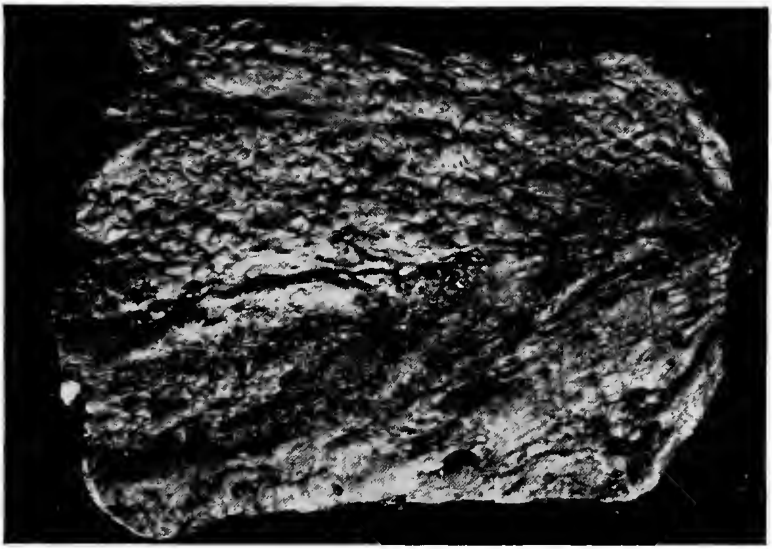

Fig. 69.—Bovine Tuberculosis. (*M. H. R.*)
Tubercles on the great mesentery.

well as to muscles, and must always hold true. Animals cannot remain permanently healthy without a reasonable amount of exercise, sunshine, and fresh air. If lungs are used less than nature intended, they must necessarily lose in tissue nutrition and vitality, and gradually become absorbed or diseased. It is reasonable to expect such lungs to become tuberculous, for cattle and people alike have frequent opportunities for infection. We must realize that nature's laws cannot be violated without paying an inevitable penalty.

It is unwise to buy cattle for breeding purposes without knowing that they are free from tuberculosis before placing with the herd. All sires, and it is especially true of cattle, should have abundant exercise in open yards or on treadmills, or be driven or worked. Ventilation must be thorough, and barns should be constructed with a view to allowing the entrance of unlimited sunshine. Sunshine may spoil the luster of hair, but it also kills germs.

Summary. — Do not found a herd with tuberculous stock. Do not introduce the disease while trying to improve a herd. Do not allow suspicious animals to stand in stable with healthy ones. Avoid incautious breeding and close confinement. Ventilate freely. Allow plenty of fresh air, exercise, and sunshine, especially to breeding stock.

All breeding cattle should be bought under tuberculin test. Buy from a sound, *i.e.* tuberculosis-free, herd. It is much safer to buy from a sound herd than to buy even under tuberculin test from a tuberculous herd, or from a herd that has recently been badly affected.

Disposition of tuberculous cattle. — Abundant experiments have demonstrated that sound calves can be raised under favorable conditions from tuberculous cows, and even from tuberculous sires. It is sometimes practical to free a herd from tuberculosis by breeding out the disease, instead of by immediately killing all diseased animals. It is usually wise to slaughter members of the herd which the owner does not think it advisable to keep in quarantine at a somewhat increased expenditure of time and money. It is generally recognized that tuberculous animals should be slaughtered under inspection and certain carcasses passed as fit for food purposes.

Tuberculous cattle retained for breeding must be kept in a separate stable or in a tightly partitioned-off portion of the common stable. They must not be watered at the same tank as the healthy cattle, nor fed from common mangers or vessels. The danger in allowing tuberculous and non-tuberculous cattle to associate in the open air is much less.

The tuberculous cows may be used for breeding purposes, and one or more crops of calves secured before the cows are finally disposed of. The calves should be raised upon the milk of healthy cows, or boiled milk from tuberculous cows, and kept out of infected stables and away from the diseased cattle. From 80 to 90 per cent of such calves may be raised free from tuberculosis in this way.

LECTURE XLI

THE TUBERCULIN TEST FOR TUBERCULOSIS

Tuberculin is usually seen in fluid form and is then a thin, watery, straw-colored fluid, slightly more viscid than water, due to the presence of glycerine used in making up the solution.

Tuberculin is a chemical product from the bodies of the bacilli of tuberculosis, and is made as follows: a certain kind of broth is infected with the bacilli of tuberculosis. The bacilli are then allowed to multiply and grow in this medium until it has become charged with this germ product, tuberculin. The whole fluid is then heated to kill the bacilli and filtered through porcelain. The germs are thus killed by heat and then filtered out. Tuberculin is therefore not only germ-free, but has also been raised to a high temperature and cannot be infectious.

Effect on cattle. — Careful experiments have demonstrated that tuberculin has no important effect, favorable or otherwise, upon the health or milk flow of sound cattle; and that the effect on tuberculous cattle is favorable rather than otherwise. An experiment was conducted at the Minnesota Experiment Station a few years ago, which included 23 sound and 5 tuberculous cows, and compared the total milk flow and total butter fat of the herd for the week prior to test with the week of test. In this experiment the cattle were given ordinary handling, neither very rough nor unusually gentle.

There was a moderate decrease in the milk flow during the two days of test, not more than could be easily accounted for by unusual handling of the cattle and the presence of

strangers. This decrease was almost made up during the succeeding five days. There was a slight increase of butter fat during the week of test. Both variations were easily within the limits of normal variation.

The experiment with the five tuberculous cows gave about the same results, the difference being easily within the limits of normal variations, neither the total milk flow nor total butter fat being materially affected by the test. Similar experiments have been made elsewhere, the results agreeing very closely with this general statement. It is undoubtedly possible for cattle to be so roughly handled during test that the milk flow might be seriously affected, but this cannot be charged to the tuberculin. In cases where serious results accompany or follow tuberculin tests, the disturbance can usually be traced to some cause other than tuberculin.

Accuracy. — Averages of very large numbers of animals tested show that tuberculin has had an average accuracy in diagnosis of over 95 per cent, and in the hands of many veterinarians who have been very careful in their work it has been almost infallible. Very advanced cases sometimes, although rarely, fail to react. Such cases are easily detected by ordinary symptoms, as a rule.

The test. — Any number up to 60 or 70 may be included in one test. Larger numbers can only be handled to advantage by one who is thoroughly familiar with the test and who can use a number of thermometers.

The injection is made on the neck just in front of the shoulder or on the flat of the rump.

At least two assistants are needed: one to hold a lantern and assist in managing the cattle, another to hold some sort of a tray, usually a short piece of board, for carrying the needed materials. There will be needed a veterinary hypodermic syringe, holding 3 to 5 c.c., and provided with several short and reasonably strong needles. The syringe should be first sterilized.

If the operator is without sufficient help, a bicycle lantern can be held in one hand while he is making the injection

with the other. The needle should be short, of fair size, and inserted by a quick stab, entering at right angles to the skin surface. Some cattle are inclined to kick just as the operator steps out of the stall. This can be prevented by an assistant giving the tail a vigorous pull sidewise at the right moment.

A very satisfactory place for the injection is on the upper and muscular portion of the rump. This avoids the necessity of going into the stall.

Two periods. — The time of each test is divided into two periods: (*A*) the day before, and (*B*) the day after injection. During (*A*) the temperatures are taken at 8 A.M., then at 2 and 6 P.M. The tuberculin is then given by hypodermic injection at 9 to 10 P.M. During (*B*) the temperatures are taken at 6, 8, 10, and 12 A.M., 2, 4, and sometimes 6 and 8 P.M.

The thermometer. — Self-registering thermometers, commonly known as fever or clinical thermometers, are necessary for this work, and they should all be correct between 100 and 105 F. All thermometers used should first be tested on the same animal or in warm water and the records compared. Any thermometer which varies one degree or more from the records shown by the others should be discarded.

Temperatures are taken by inserting the thermometer into the rectum or vagina, usually the former. If a number of cattle are being tested and several thermometers are in use, the latter may be secured to the tails for safety. This may be easily done by a simple wire clamp, or even by shoestrings tied so as to give the tail a few inches of play. This permits the operator to use a large number of thermometers, and prevents them from falling to the floor and breaking.

Dose. — The dose is about 1 c.c. or ¼ dram Bureau tuberculin per 500 lbs. live weight. The doses may be taken directly from the bottle, or one or two bottles at a time may be emptied into a small vessel, from which the doses can be more conveniently drawn into the syringe.

Cautions. — The cattle must be kept under the same conditions as nearly as possible on both days; *i.e.* watered at the same hours and fed at the same hours on each day, given as nearly as possible the same amounts, and treated alike on the two days in every respect.

There are several possibilities of error if operator is not careful, accurate, and observing. The cattle must not be excited or worried in any way but kept as quiet as possible during the whole test. If the whole stable or any portion of it be much warmer on the second day than on the first, or if any cattle are allowed to become thirsty, or to go much beyond their feeding time, or drink large quantities of cold water, note should be made of the fact and it should be considered in making the diagnosis in doubtful cases.

Cattle that show high temperatures during period (*A*) should ordinarily be released from test, except in case of heavily pregnant cows. These may be tested, if carefully handled, up to within a short time before calving. It is always possible that an animal may show normal temperature during (*A*) and then be feverish from causes not connected with the test during (*B*). This rarely occurs, but the possibility must be borne in mind.

On the other hand, a large quantity of very cold water drank may reduce the temperature one or two degrees at a critical time in a low reaction.

Importance to breeders. — The value of the test to breeders lies in the fact that it enables them to know whether their cattle are free from tuberculosis, and it enables them to free their herds and put them on a sound and healthy basis in case they are diseased.

Diagnosis is made mainly upon the fever reaction: *i.e.* if the temperature rises, between 8 and 20 hours after the injection, about 2.5 degrees or more above an ordinary normal range, as shown by comparison of the (*A*) and (*B*) temperatures, and careless errors have been avoided, it is safe to diagnose tuberculosis. A rise of 1.5 or less than 2 degrees may be called suspicious and the animal held for

future retest. If the normal temperatures run low, *e.g.* 100 F. or less, we would not ordinarily condemn on a 2 degree rise. Experience and judgment are very necessary in this work.

The reaction. — A typical reaction is one wherein there is gradual rise and gradual decline. Very abrupt changes should be verified with a different thermometer. One or two high temperatures during (*B*), with the others normal or nearly so, should not be considered as more than doubtful or suspicious.

Animals that react sometimes show diarrhea and a local swelling at the site of injection, perhaps with shivering.

DIETETIC DISEASES

LECTURE XLII

AZOTURIA

Prevalence. — Azoturia is a common and very serious disease which affects horses under certain well-defined conditions. It is frequently fatal. It affects the best and most valuable horses, and is so very easily prevented that it would seem as though the farmer should be familiar with this disease, and his knowledge should come along other lines than that of sad experience. Farm horses in the Northwest do comparatively little work during the winter, and are in high flesh when early spring work opens. This condition, together with the fact that the early spring is necessarily a season of irregular work, will explain why so many cases of azoturia occur during the spring months.

History.—Azoturia rarely appears among horses at pasture or among those doing regular work, but almost invariably *during exercise after a period of idleness on full feed which has succeeded a previous period of work.*

This disease is frequently confounded with colic; sometimes farmers call it spinal disease, and sometimes it is thought to be an inflammation of the kidneys; but it is easily distinguished from any of these by the history, which is very uniform, by the symptoms which appear, and by the condition of the urine.

Parts affected. — This is not a disease of the kidneys, as one would naturally think from the color and condition of the urine, but primarily a disease of the muscles, then of the blood and nervous system. The blood is dark and

tarry, has a varnish-like gloss, and does not coagulate after death. The liver and spleen are engorged, and may be more or less disorganized after death.

Duration. — Mild cases may recover in three or four days. The more severe cases either die in a few days or there may remain a persistent and more or less complete paralysis of the hind quarters and limbs for several weeks.

Causes. — Predisposing and precipitating.

The *predisposing causes* are the factors which favor the development of the disease, and include the following: high flesh, diet rich in proteid, and full feed during a period of rest, following a period of regular work. Most cases appear during the prime of life. Mares are more frequently affected than geldings, but all are liable.

The chief precipitating factor is *active exercise, following idleness on full feed,* under conditions above given. It is probable that there occurs an accumulation of surplus proteid matters in the system during the period of idleness, which are rapidly disorganized when exercise begins. Just how this excess of proteid matters in the body serves to develop the disease, and what is the close connection between this condition and the symptoms which appear, are matters of interesting scientific speculation but need not be discussed here. What part may be played in this disease by sudden exposures to cold after confinement in warm, damp stables is a point of dispute. Some very good and recent authorities ascribe a very prominent place to this condition among the causes of azoturia. It is quite possible that the two conditions of accumulated proteids and sudden exposure to cold may be associated in many cases.

Symptoms. — The symptoms appear suddenly with little or no warning and are very uniform. The horse frequently comes out of the stable feeling unusually well, then after going a short distance there is a sudden lameness or stiffness in his hind legs. Sometimes both are affected alike, but usually one first. The horse staggers, is very weak on his hind legs, and may fall before he can be unhitched.

These patients perspire very freely before and after going down; the muscles over the loins and hips are rigid to the touch, frequently tender on pressure, and may tremble or twitch.

The *urine* is highly colored, varying from red to almost black, and is usually increased in specific gravity; *i.e.* heavier than natural. This abnormal color is due to the presence of the red coloring matter of the blood and voluntary muscles (lean meat), and may be absent in mild cases.

The pulse may run up to 60 or 80 per minute (normal, 42 to 48); the temperature may be increased to 102 or 104 (normal, 101.5), but in many cases the pulse and temperature vary but little from the normal. The bowels may be normal and the appetite fairly good in mild cases. The skin sensation may be diminished, as shown by pricking with a pin. The natural peristaltic action of the intestines may be suppressed, but the bowels will usually vacuate under the influence of an injection or other local irritation. A chronic paralysis affecting one or both hind limbs may be a very troublesome factor in the case.

Prevention. — Prevention is simple, easily applied, and without expense, and this is the point that should be considered by the farmers, rather than treatment, which is frequently unsatisfactory even when the patient recovers; moreover, one attack predisposes to others. A horse that has had azoturia once is very apt to have it again, and the second attack is more easily brought on than the first. Preventing the first attack may be the prevention of several attacks and of the final death of the horse.

There is but slight danger of azoturia for the horse that is thin and weak, for the young colt or for the aged horse, for this disease usually affects the best horse in the barn, one in good flesh and in the prime of life. When such a horse has been working on full feed for a time and must then stand idle for a few days, or even twenty-four hours, *make a very large reduction in the grain ration*, or stop all the grain if the horse is quite fat, for a fat horse needs but little

grain when standing idle under any conditions, and especially is this true if he has recently been at work. Allow plenty of water and turn out in the yard every day if possible. It would be still better if the horse could be continued at light work. When such a horse has been standing for some time after previous exercise, and the grain has not been reduced as it should have been, the next best thing is to give a decided cathartic, *e.g.* a quart of raw linseed oil thirty-six hours before hitching, and then work very moderately the first day, for quick or violent exercise seems more liable to bring on an attack than slow and gentle use. This should be borne in mind when taking any horse out for the first time after a period of idleness.

Treatment. — These are difficult cases to treat, and *this part of the work should be done by competent veterinarians* whenever such are accessible. The treatment of azoturia is frequently unsatisfactory, even with the most skillful practitioners in charge. The principal purpose of this lesson is to direct the attention to prevention and not toward treatment; but cases will arise, through the hired man's anxiety to have his horses look well, when the owner is in no wise to blame, and these cases will occur, too, in sections where competent veterinarians are not located.

If not voided naturally, means should be taken to draw the *urine* as soon as possible after the disease appears, and three times daily thereafter. This may frequently be accomplished by inserting a hand in the rectum and pressing down on the bladder. This is an important feature in the treatment of severe cases. The azoturia patient has a much better chance for recovery if he can be kept upon his feet a portion of the time at least, and it is very desirable that this be done for several reasons; but slings should not be used unless the patient can support a portion of his weight upon the limbs. When the patient is unable to do this, put him in a clean, dry stall with plenty of bedding and turn him three times daily until he can stand with the aid of a sling.

Many different lines of treatment have been used by veterinarians during recent years, with differing and even conflicting opinions as to results. Common baking soda has been used in large, *e.g.* half pound, doses. Some veterinarians with wide experience believe they get best results with good nursing and very little medical treatment.

Recently reports have been made from American and German sources concerning unusually good results from the use of adrenalin, especially in early stages. These reports need further confirmation but appear encouraging. The doses reported are about 1 dram of adrenalin chloride solution in about 3 oz. water, and usually three times a day.

One old line of treatment that has been much used and indorsed by best authorities is essentially the following: Cases that show difficulty in breathing with full pulse may be bled from two to four quarts, depending on the condition of the pulse, then give one quart of raw linseed oil, or, better, give one ounce of aloes with two drams ginger made into a pill with a little molasses; encourage the horse to drink as much as possible; if he will not drink freely, he should be drenched with water or be given weak salt brine to make him thirsty. The more he drinks within reasonable limits the better. If restless and violent, the patient should have a sedative; *e.g.* one oz. bromide of potassium with three drams fluid extract of gelsemium, given in half a pint of sirup. The muscles of the hips and loins should be fomented with hot water twice daily, two hours each time during the first three days of the illness, and after this a stimulating liniment should be used over these muscles twice daily until the patient has recovered.

One or two hours after the physic and sedative dose two tablespoonfuls of the following prescription may be given in half a pint of cold water or sirup, every two hours, until all is given: —

F. e. colchicum sem.	1 oz.
F. e. pilocarpus	3 oz.
Spirits æth. nit.	6 oz.

The purpose of this prescription is to stimulate and assist the kidneys and skin to excrete rapidly. When chronic paralysis remains after the acute stage has passed, nux vomica should be given. Give one to two drams fluid extract nux vomica or one to three grains strychnine sulphate twice daily in feed, beginning with small doses and gradually increasing until there appear symptoms of nervousness and muscular twitching, when the dose should be discontinued or rapidly reduced.

Prognosis. — *Estimates of results* must be given with great caution, for sudden and unexpected changes may occur. Perhaps 40 to 60 per cent die in general practice. Prognosis is bad when complete paralysis occurs; when the disease develops violently from the start, the horse going down at the beginning and soon losing control of both limbs; or when the patient grows more and more restless during progress of the disease, or is unable to stand or support part of the weight in the sling. If patient can stand alone, or can stand fairly well when assisted by sling, the prospects are favorable without much medical treatment.

LECTURE XLIII

HOVEN OR BLOAT

Definition. — A form of indigestion in cattle and sheep characterized by an abnormal collection of gas in the first stomach or paunch.

Causes. — Bloat is caused by excessive fermentation, which results indirectly from such conditions as sudden changes from dry food to pasture, or from one pasture to a better one, or from grass to clover. Grasses or clovers seem more apt to cause hoven when the dew is on, or after

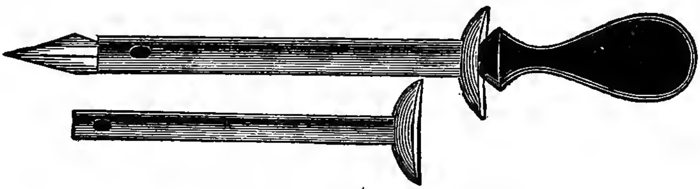

FIG. 70. — TROCAR AND CANNULA.
For tapping bloated sheep and cattle.

a rain. Frosted roots and impaction from overfeeding may also result in arrested digestion, and then hoven ensues. Sick cattle frequently bloat after lying for a long time on the side.

Why cattle and sheep are more apt to bloat when the dew is on the grass, or after a rain, may be explained theoretically in this way: The grass is more palatable and also heavier, the cattle eat more rapidly; more air is swallowed with the food, and they eat more than at other times. This larger quantity of food makes such a large and heavy mass in the stomach that the involuntary fibers are partially paralyzed. By reason of the weight and stretching, diges-

tive processes are checked and fermentation goes to excess. Gas accumulates until the stomach may be greatly distended.

Symptoms. — There is extreme distention of the stomach, which is most prominent on the left side, and difficulty of breathing. The pulse may be nearly imperceptible. The animal moans, may stagger and fall, then die in convulsions.

Treatment. — If breathing is difficult, do not wait for the effects of medicines, but tap with trocar, as shown in class,

FIG. 71. — SHOWING WHERE TO TAP. (*M. H. R.*)
See white cross in the flank.

high in left flank and well forward. (See Fig. 71.) The tube may be left in some time if gas continues to accumulate. Then give the following as one dose in ½ pint of sirup: —

(*A*)	Aromatic spirits of ammonia	1 oz.
	Turpentine	1 oz.

This is a suitable dose for a thousand pounds live weight.

Repeat every half hour until gas ceases to accumulate or until 6 doses have been given if necessary: or (*B*) give 4 oz. hyposulphite of soda in 6 oz. water every half hour until gas ceases to accumulate or until a limit of 6 doses has

been given; or (*C*) give (*A*) and (*B*) alternating, one half hour apart. Do not exercise the cow or sheep when badly bloated. This is dangerous because the breathing is so greatly interfered with by the pressure of the stomach against the diaphragm. When the acute symptoms have subsided give the following for physic: —

(*D*)	Epsom salts	1 lb.
	Glauber salts	$\frac{1}{4}$ lb.
	Common salt	$\frac{1}{4}$ lb.
	Ginger (ground)	3 oz.
	F. e. nux vomica	3 drams.

Dissolve (*D*) in three pints hot water and give as a drench; repeat in 16 hours if bowels do not move freely.

Prognosis. — A large proportion of cases recover when properly treated soon after disease appears.

Prevention. — A large proportion of these cases may be prevented, but hoven will appear occasionally under conditions which cannot be prevented. Avoid as fully as possible the conditions that have been cited as causes. There are two methods of turning cattle and sheep on new pasture in the spring or at any season; from one pasture to a richer; or from grass to clover, with reasonable safety. *First* — Feed well and then turn them on but a few minutes the first day, and increase this time each day for a week. *Second* — Give the cattle or sheep a large ration of the dry food, to which they have been accustomed, on the evening before they are to be turned on; repeat the large ration of this food the next morning, feeding much later than usual, and then turn them out as soon as done eating, which should be after the dew is off the grass and not soon after a rain. Under these conditions cattle and sheep usually may be turned on grass in the spring or on new or different pasture with little risk. Never make such change when the grass is wet from dew or rain.

Pastures where the old grass stands quite heavy on the ground and the young grass grows up in such a way that

the stock must eat the two together, are much less dangerous than those where the stock gets only the new grass.

Causes of death. — There is usually carbonic dioxide gas poisoning and actual suffocation. Rupture of the stomach or diaphragm often occurs and is of course rapidly fatal.

LECTURE XLIV

CHOKE

Explanation. — Choking, as ordinarily understood, is an obstruction in any portion of the pharnyx or esophagus. In horses this is more commonly caused by dry food, and this usually occurs in the case of horses which are rapid eaters. Cows more frequently choke on pieces of roots, pumpkins, and old bones. Those cases where a long section of the esophagus is packed with soft, dry food are especially difficult to handle successfully.

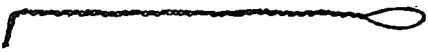

FIG. 72.—FOR RELIEVING CHOKE. (*M.H.R.*) Made of No. 10 or 12 wire.

Symptoms. — The horse or cow stops eating suddenly and makes ineffectual efforts to swallow, then there are spasmodic actions of the neck muscles. When the animal attempts to drink, the water returns partly through the nose. If the obstruction is of considerable size and along the neck portion of the esophagus, it may usually be seen or felt. There is usually a profuse flow of saliva, and particularly in the case of cattle an involuntary chewing action. If the choking occurs in the thoracic portion, then medicines or liquids are swallowed in small quantities without difficulty until the esophagus is full, and return by the mouth, the animal being apt to cough. There is usually marked dejection and distress, with an appearance of anxiety. Food and water are refused. Cattle frequently bloat.

Prevention. — Roots should either be sliced or pulped. It should be borne in mind that cows usually choke when eating hurriedly, especially when attempting to swallow something under threatened attack from some other member of the herd. Horses choking on dry feed are almost

invariably rapid eaters, and for such horses it is well to avoid dry bran. The grain, especially oats or similar food, should be given in such a way that the horse must get it slowly. The grain may be scattered over the bottom of a large manger. Any device which will force the horse to eat slowly will avoid the difficulty in normal cases. It should also be borne in mind that an animal which has been choked is very liable to have a recurrence of the same difficulty during the first week or two after the accident.

Treatment. — If the obstruction is within reach, it should be removed by the hand, the teeth being held apart by some suitable device to protect the arm. A person with long arm and slender hand can frequently relieve choking in the pharynx or upper portion of the gullet, especially with an assistant to shove the obstruction upward toward the hand. A thin glove with the ends of the fingers cut off is desirable to protect the hand.

By coughing. — Dry food that cannot be reached by hand should be softened by the use of oily or mucilaginous drinks, and then gradually worked loose by manipulation. The simple device of forcing the horse to drink enough to fill the upper portion of the esophagus may be resorted to. The horse will usually cough, perhaps expelling a portion of the loosened obstruction. In case the horse does not cough, he can be induced to do so by pinching the larynx and releasing suddenly. In this way considerable portions may be removed at each fit of coughing. A small portion may be loosened from the upper end of the obstruction and the animal may be induced to cough. Then another drink is given, and the manipulation and cough are repeated. Frequently the obstructing mass can be loosened at the lower portion, and the loosened portion swallowed if the obstruction is high.

If the choke is along the neck and on dry feed like oats or bran, then water or raw linseed oil may be injected directly into the dry mass, with a good hypodermic syringe.

Such a choke may often be relieved very satisfactorily

by simply washing out the mass through a double-current stomach tube. This method is applicable whether the choke is along the neck or within the chest. Probang should not be used in cases where the choke is due to dry food.

Mechanical means. — Solid bodies, like pieces of roots, may be either shoved down to the stomach, or drawn upward by means of a corkscrew probang. The probang consists of a smooth flexible tube of suitable size, with a central rod, upon the end of which there is placed (in some makes) a sort of corkscrew. This is withdrawn into the tube during introduction; when the end of the probang touches the obstruction the central rod is shoved forward and the corkscrew worked into the root or whatever the obstruction may be. If the obstruction fails to withdraw, it is at least broken up and softened to some extent every time the corkscrew is introduced.

The simple device shown in figure No. 72 is very satisfactory for relieving cases of this kind. It consists of a piece of No. 10 or 12 wire, about 12 feet long; the ends bent together and twisted as shown in the cut, leaving a suitable loop at what was originally the middle of the wire. This is introduced into the gullet like a probang. The farther end passes the obstruction, which is then included by the loop; the wire is withdrawn and the obstruction is loosened, moved upward a short distance, or removed entirely. If the instrument merely loosened the obstruction, then the process is repeated. This has proven most satisfactory in the writer's experience. In all work of this kind the nose should be extended and the gullet kept in as straight a line as possible.

The *probang* or wire loop should be introduced slowly and carefully. If the animal coughs, the instrument should be removed and another trial made, as the coughing indicates that the instrument has entered the trachea. The introduction and after use of these instruments must be very gentle and cautious.

Whole eggs that have been partly swallowed may be punctured by a large needle and then easily crushed.

Tense, spasmodic action of the gullet may be controlled by the use of morphine or aconite.

Whips and other stiff rigid instruments must be avoided, as they are very apt to tear the gullet just below the pharynx. Whatever is used must be smooth and flexible. The after treatment consists of soft food, for at least a week.

LECTURE XLV

HEAVES

Definition. — This is a disturbance of the process of respiration characterized by easy inspiration and difficult expiration, the air being forced out by two distinct movements. This disease is usually conceded to be an indirect result of a disturbance originating in the stomach and affecting the lungs through the pneumogastric or tenth cranial nerve. Both these organs receive a portion of their nerve supply from this large nerve. This nerve gives very delicate sensibility to the larynx, pharynx, esophagus, and stomach, and gives motor nerve fibers for the bronchial tubes, esophagus, and stomach.

Future information may easily show that this theoretical nerve disturbance is not sufficient to account for many cases of ordinary heaves, but it is evident that true heaves is usually associated with the feeding of considerable quantities of timothy and clover hay.

Heaves lessens very materially a horse's value and usefulness. Horses so affected are often unthrifty by reason of chronic indigestion. Light feeders are as a rule free from heaves, and the horse that eats hay greedily is the one most liable to have heaves.

Asthma is very similar to heaves in some respects, and it is well known that persons having a tendency to asthma may very easily have attacks brought on by overeating, or by eating indigestible materials.

In the lungs of horses affected with heaves the air vesicles are gradually dilated, losing their elasticity; they may even rupture together so as to produce small cavities from which the air is expelled with great difficulty. During forced

expiration, the air may escape into the surrounding tissue. This emphysema, or air escaping from the air cells into the lung tissues, usually occurs in connection with heaves, but its relation to the disease is quite problematical. Plainly a horse may have such emphysema without heaves, but rarely heaves without the emphysema. This condition is probably to be regarded as an effect rather than a cause.

Cause. — Heaves is generally conceded to be a reflex nervous disturbance through the stomach branch of the tenth cranial nerve, which nerve also supplies in part the heart and lungs. We may say that the direct cause of heaves is excessive eating of bulky food, especially hay that is overripe and dusty, or worse — musty. Tame hay cut very ripe and dusty clover hay are both prone to cause this trouble. Heaves rarely if ever develops in horses in pasture or that have only bright, wild hay or a reasonable quantity of early cut tame hay. This disease is said to be almost unknown in arid regions where timothy and clover hay are grown by irrigation, and where such hay is never exposed to dew or rain and therefore does not develop fungi to a serious extent. Mere bulk and overripeness are probably not the only factors. Many cases of heaves may possibly be due to fungi or their products rather than to the character of the food with which the fungi are taken.

Symptoms. — A peculiar, explosive cough usually appears before the breathing becomes much disturbed. After a time it is noticed that exercise produces unusual difficulty in breathing, the air being taken in quite easily but expelled with difficulty. When this stage develops, the air is expelled in two efforts instead of one, the latter portion of the tidal air being expelled by a special effort of the belly muscles. Overfeeding, of course, increases the difficulty.

Some cases of heaves may be disguised temporarily by the use of drugs and feeding on concentrated diet. This trick may be detected, however, by allowing the horse a hearty feed and water, and then giving active exercise, or even active exercise without the special feeding and water. It

is usually easy to distinguish heaves and roaring. The latter is a disease of the larynx due to paralysis of one of the laryngeal cartilages. It is shown by the abnormal sounds known as roaring or whistling, the movement of the flank and chest being normal in character.

Prevention. — The prevention of heaves may be very easily stated and almost as easily accomplished, by mere avoidance of well-known causes. There is a very general and very wasteful feeding of hay among farmers. This is not merely a waste of hay; it is more than that; — an injury to the horse. A case of heaves is a discredit to the owner or at least to the feeder, but on the whole, a rather creditable thing to the horse. Heaves indicates that the horse is a good feeder and under wiser management would be able to take and digest a large amount of food and do hard work. Question often arises as to whether owners of mares should patronize a stallion affected with heaves. It has always seemed plain to the writer that heaves is not at all objectionable to the stallion, but rather a credit to the horse, indicating that he is a good feeder and liable to sire hearty colts.

It is not wise to allow a horse to do very fast or hard work on a distended stomach, which means that during the first hour or so after hearty meals the work should be slower and easier. Little hay should be fed in the morning, and less at noon, with a fairly good feed in the evening.

To prevent heaves, then, feed reasonable quantities of good wild hay or tame hay cut early and not allowed to become musty. Avoid all dusty foods. The amount of hay should be restricted to much less than is usually fed. Horses that are greedy feeders should be bedded with sawdust or shavings or protected by a muzzle in case other bedding is used.

Autopsy. — On examination post mortem the lungs may be found to be somewhat bloated and to contain more air than normal. The chambers in the right side of the heart are apt to be enlarged and their walls thickened. In ex-

amining the lungs of long-standing cases of heaves, we note that they are pale and float abnormally high in water, due to the emphysema or air in the tissues previously mentioned. The stomach is usually larger than normal, due to overeating of bulky foods and consequent stretching.

Treatment. — Avoid overripe and dusty hay. Feed little hay, and avoid much bulky food of any kind. Give but little hay for the morning feed, none at all at noon, and a moderate feed in the evening, but much less than would be considered careful feeding for a healthy horse. If the hay or grain is at all dusty, sprinkle it as a regular custom. Use horses affected with heaves for slow work, and give as much rest as possible after meals.

Medical treatment is considered unsatisfactory so far as curative effect in bad cases is concerned. Fowler's solution in one-ounce doses 3 times a day in the feed, long continued and coupled with careful feeding, is often a great help. Proper feeding alone may be said to be almost curative, although subsequent attacks are easily brought on by injudicious management.

LECTURE XLVI

LAMINITIS

Definition. — This is a painful and rather frequent disease of horses, — commonly called founder. It is essentially an inflammation of the sensitive parts within the hoof, and takes its name from the sensitive laminæ. This disease is more common in the front feet, but may affect any of the feet — one or more.

Symptoms. — The horse usually persists in lying down. There is unmistakable evidence of extreme pain. The respiration, pulse, and even the temperature may be increased as a direct result of the great pain. The pulse is full and strong. If the disease affects the front feet, the horse carries as much of the weight as possible upon the hind feet, with the two front limbs projecting forward. If the hind feet are involved, the horse stands with the two front feet back under the body, carrying as much weight as possible, with the two hind feet extending forward so as to relieve the sensitive parts from pressure.

Cause. — Laminitis results from profound disturbances of the circulation. The unyielding horny box does not permit expansion of the inflamed tissues, hence the great pain that is invariably manifest in this disease. This disorder may have its origin in an unusual overfeeding; or in a large quantity of very cold water taken when a horse is very hot or tired. It may be a result of forcing a horse to stand on hard footing for a long time. Concussion on hard roads, exhaustion, and exposing a hot horse to cold wind or driving through cold water, may all serve as causes of laminitis or founder. It sometimes occurs in one front foot, or one hind foot, as an indirect result of lameness in

the opposite limb. The horse overworks the sound limb in order to relieve pain in the previously lame one, and thus causes laminitis in the foot which had previously been sound. Laminitis not infrequently follows a pneumonia or bronchitis; sometimes inflammation of the bowels, and apparently without other direct exciting cause.

Pathology. — There is first of all an inflammation of the sensitive parts within the hoof, especially the sensitive laminæ. This is followed by an exudate, which may be either slight or considerable in amount and more or less persistent. In persistent cases, with considerable exudate, the toe of the os pedis (third phalanx) is gradually pressed downward against the sole. The sole may thus gradually become convex, and the horse becomes permanently unsound.

Termination. — Laminitis may terminate in recovery and practical restoration of the affected parts, or there may remain a convex sole and a chronic soreness with a tendency for the hoof to grow in an unnatural shape, see figure 73. The wall becomes wrinkled transversely, and grows unevenly.

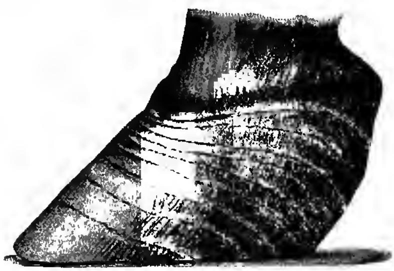

Fig. 73. — A Foundered Hoof. (*B. A. I.*)
An old case.

Treatment. — These are usually serious cases, and should always have the benefit of professional attendance and skill if such is obtainable. Any general treatment that could be suggested might be unwise in some cases, and unwisely applied in others.

A treatment that is frequently satisfactory consists in keeping the feet wet with cold water (45° to 50° F.) for a long period of time, several days if necessary. Sometimes this may be done by standing the horse in a shallow stream, preferably with a soft bottom. Some good veterinarians prefer to use warm water for an hour at the beginning,

then change to cold water and continue the cold water as suggested. When a horse must be kept in the stable, he should have a large box stall with deep, soft bedding. If he is compelled to stand for any great length of time in order to keep the feet in cold water, then he should be supported by a sling. Severe cathartics should be avoided — but it may be desirable to give very mild doses of aloes, or raw linseed oil. A dose of the former for this purpose would be one half ounce or less; the dose of the latter would be about one pint, either repeated as necessary. Coupled with this, two to three or even four ounces of saltpeter may be given, dissolved in drinking water, or as a drench in a pint of water three times daily for acute cases. Ordinarily the shoes should be removed. The toe, if long, should be shortened, but the sole should not be thinned or otherwise interfered with. If the horse is compelled to stand, he may stand more comfortably with shoes that are high in the center and rocking backward toward thin, flat heels. If the pain is extreme, and not controlled by the resting upon soft bedding and continuous application of cold water, then some preparation of opium should be given — as a matter of humanity, if for no other reason. The dose of laudanum is about one ounce, and may be repeated two or three times a day, if necessary to control the extreme pain. If an acute case can be induced to lie down, even by throwing some horses by ropes the first time, great relief and rapid improvement in respiration, pulse, and pain are soon noted.

Prevention. — Intelligent care will prevent most ordinary cases of laminitis.

Accustom horses to markedly changed conditions gradually. This applies especially in case of fat and idle horses put to work and to country horses put on city pavement.

Keep the heated horse out of cold winds and cold water. Avoid overfeeding and overdriving, and feed a hot horse or tired horse very cautiously.

LECTURE XLVII

LYMPHANGITIS

Definition. — Lymphangitis is an inflammation of the various lymphatic tissues. It appears suddenly; is quite painful; and rarely fatal.

Cause and history. — This disease usually appears among heavy horses of sluggish temperament. Such horses seem very much more susceptible than horses of different type. It almost invariably occurs among horses that are full fed and after a period of idleness, perhaps only a day.

Symptoms. — This disease usually makes its appearance with a chill which is followed by fever. The horse is uneasy and in evident discomfort. A sudden swelling appears on the upper portion of the hind limb on the inside. The swelling increases gradually and extends around the limb and then downward. Certain lymph glands high up in the inguinal region or groin become involved. These may even develop abscesses, but this is very rare. There may even occur actual death of the patient from septic infection in rare cases.

The horse is quite lame, and the affected limb is very sensitive to the touch. The horse perspires freely. The pulse is increased. Respiration is hurried somewhat, and the temperature is raised. The bowels are constipated. The urine is usually dark, colored, and scanty.

This disease develops for about two days and maintains its severity for about the same period, and then there is a gradual abatement in typical cases. Most of the swelling in the limb subsides, and as this general swelling goes down, the inflamed lymph vessels appear as long, cordy swellings. There usually remains some thickening and enlargement of

the leg, and this disease is apt to recur, each time leaving something of an increased enlargement until there is finally developed what is commonly known as elephant leg.

Lymphangitis might possibly be confused with simple dropsy or with farcy. It can be distinguished from simple dropsy by its acute pain, its fever, lameness, and cordy swellings. Lymphangitis may be distinguished from farcy by its more acute fever and more acute local trouble in the leg; by its early inflammation of lymph glands in the groin, and absence of farcy buds.

Prevention. — The grain ration should be very greatly reduced during idle periods. This is true for any horse in fairly good flesh, and particularly true of horses of the type that has been mentioned as especially subject to lymphangitis.

Treatment. — Prompt and vigorous treatment seems to abort the disease in a fair proportion of cases. Hot fomentations over the swollen part, to be continued for several hours, is one of the most important parts of the treatment. Between the periods of fomentation there should be given vigorous friction, rubbing upward, and long-continued light exercise. If the horse is able to walk, he should be kept moving about slowly for several hours at a time. During the first 3 or 4 days and until the active symptoms abate, and until the horse is again receiving normal exercise, the food should be light and laxative. Later the horse may be returned to full feed.

Bleeding is advocated by good authorities for acute cases with high fever. Four or five quarts may be drawn for this purpose from the jugular vein. A moderate physic should be given: *e.g.* 4 to 8 drams of aloes in a physic ball or $\frac{1}{4}$ pound Epsom salts dissolved in a pint or so of water 3 times a day may be substituted for the aloes. Two-ounce doses of saltpeter should be given 3 times a day, for one or two days, each dose given either as a drench dissolved in two pints of water, or it may be conveniently given in the drinking water if the horse will take it so.

Prognosis. — Lymphangitis usually ends in recovery so far as the general disturbances are concerned. Something may be estimated concerning the probable duration of illness by noting the severity of the chill which comes at the beginning of the attack.

LECTURE XLVIII

PARTURIENT PARALYSIS (MILK FEVER)

Causes. — Predisposing and precipitating.

Predisposing causes. — Age (maturity), heavy feeding and milking qualities, pregnancy, easy delivery, lack of exercise, and high temperature in stables.

The cow that is in the prime of life, with her third or fourth calf, and that is a heavy feeder and milker, is the one most subject to this disease. Cows in thin flesh, that have been underfed during pregnancy, are not liable to have this disease. Neither are young heifers nor old cows.

Precipitating causes. — Delivery, sudden increase of gland activity in the udder, disturbance of circulation, anxiety, exposure to cold and damp.

Schmidt's theory was that certain chemical poisons are formed in the udder, absorbed into the blood, and circulated throughout the body, reaching the brain and spinal cord through the general circulation, and producing the general symptoms of paralysis of sensation and motion. Dr. Schmidt noticed that the greatest mortality occurs when the disease appears very soon after birth, and incidentally that is the period of most abundant colostrum in the udder.

A still later theory, supported by the results of various lines of treatment, is that milk fever is essentially a disturbance of blood pressure. If by any means the amount of blood held by the udder is limited, milk fever is prevented. If blood is forced out of the udder by pressure in the milk ducts, the disease is usually cured.

Symptoms. — Early, or warning, and diagnostic, or positive.

Early symptoms. — Uneasiness, sudden constipation, eyes stupid or wild, tail switches uneasily, milk flow checked.

Such symptoms should warn of danger, if occurring during first five days after calving, or within two days before.

Diagnostic symptoms. — Patient goes down; loses sensation and voluntary motion; pupils dilate; cow lies in a peculiar position with head in flank and unable to swallow; pulse is at first bounding and full — later depressed.

Prevention. — This is always more satisfactory than treatment, and is especially applicable to milk fever. For a

FIG. 74. — PARTURIENT PARALYSIS — MILK FEVER. (*M. H. R.*)
Early stage. Unsteady on hind legs.

heavy milker, sudden changes in diet should be avoided. Any change should usually be toward one lighter and more laxative. It is sometimes advisable to put especially susceptible cows up from pasture on to light, dry feed. Food should be light, laxative, easily digested, and small or moderate in quantity. A mild laxative (*a*) may be given 2 to 5 days before calving, and a cathartic (*b*) within 12 hours after calving. For (*a*) give one quart raw linseed oil. For (*b*) give 1 to 2 pounds of Epsom salts with 2 to 5 ounces powdered ginger, the dose depending on size of cow and

condition of the bowels. Allow cows abundant exercise during the last month of pregnancy, and, if a cow is nervous, leave the calf near her for a few days.

Usually there should be little or no milk drawn before calving and but little removed during the first twenty-four hours after calving, not more than the calf would take naturally. This is especially important as a preventive of milk fever with high-type dairy cows, and is satisfactory if the plan is followed with some intelligence.

FIG. 75.—PARTURIENT PARALYSIS. (*M. H. R.*)
Later stage. Head held unsteadily.

Treatment. — These cases require skill in treatment, and the affected animals are usually valuable. For these reasons stockmen should not treat these cases if competent veterinary services may be had. A line of treatment is suggested here because cases often occur where it is not possible to obtain professional assistance.

The patient must not be allowed to lie flat on the side, but should be propped up by means of bags of sand, bran, or hay, so that she lies on the sternum. If the head is thrown around violently, it should be supported by means

of a rope tied to some overhead support. The cow must also be kept thoroughly warm and dry. In bad cases, equalize circulation by vigorous applications to skin; *e.g.* mustard and turpentine. Retain heat in cold weather by four or five blankets. Preserve quiet; draw urine twice daily with catheter, and use large quantities of slightly irritating rectal injections repeated several times daily, if necessary.

Give no medicine or liquid food by the mouth except as directed by a competent veterinarian. This is because of difficulty in swallowing and the danger of producing fatal pneumonia in a case that should have recovered.

FIG. 76. — PARTURIENT PARALYSIS.
Cow very stupid. Skin has lost sensation. Head in the flank. Still later stage.

Schmidt's treatment was the first of our modern udder infection treatments, and is directed to the local seat of trouble. It has been very successful.

The udder should be well brushed, then placed on a clean towel or piece of oilcloth and disinfected with 1 to 1000 corrosive sublimate in water, or 3 per cent lysol or creolin, or 5 per cent carbolic acid. Hands of the operator and the teat tube, rubber tubing, and funnel should all be disinfected, the two latter by boiling. After the teat tube is disinfected, it should not be carelessly handled or come in contact with anything that can contaminate it. Bacterial cleanliness is of the utmost importance in the Schmidt

treatment, and also in the air-injection treatment to be mentioned later.

About $2\frac{1}{2}$ drams iodide of potash are dissolved in one quart of boiled water. One fourth of this is injected by means of a syringe or by means of rubber tubing and a milk tube through each teat into the udder. Each quarter is thoroughly milked out just before the injection is made. The solution should be injected at about 105–8° F., and left in the udder. The temperature should not be guessed at. It can be determined accurately by means of a dairy thermometer.

Treatment may be repeated in 3 or 12 hours if needed.

Air treatment. — The injection treatment for milk fever has passed gradually through several stages from iodide potash solution (Schmidt treatment) to various other solutions, then oxygen gas, and finally simple, clean air. This air-injection treatment is the one now in most common use. Apparently full distention of the udder is the essential thing, and it matters but little as to what is used to distend, providing it be clean and not irritating. Great care in cleanliness is necessary to avoid infection of the interior of teat and udder with germs which might cause garget or septicæmia (blood poisoning). The udder is given the same preparation as for Schmidt's treatment. Air is injected by a special syringe in which air is filtered through cotton before entering the udder. The teat tube must be well boiled and the utmost care used as to clean handling and the injection of clean air. The quarters are pumped full of the filtered air; it is well to give the udder massage treatment in order to disseminate air through the milk ducts during the injection process. A broad tape is tied around the teat and left on for about six hours.

The injection may be repeated in three to six hours if necessary. In an emergency an ordinary bicycle pump connected by rubber tubing to a milk tube may be used, but this, of course, does not filter the air.

Prognosis. — It is difficult to make an accurate estimate.

Sudden and unexpected variations occur. Loss under the Schmidt or air treatment is not large. The prospect is more unfavorable if: the case develops soon after calving; it develops rapidly and seems to overwhelm the system; decided loss of animal heat; tympanites or bloating; convulsions; cornea becomes insensible; lower lip hangs loosely.

Favorable if: circulation remains good; feces are passed; patient attempts to rise or eat; slight fever while circulation is still weak; if rectal or vaginal irritation causes a discharge of feces or urine.

MISCELLANEOUS DISEASES

LECTURE XLIX

LAMENESS

Definition. — Any irregularity of the gait, regardless of cause or degree.

Locating the lameness. — It is usually quite easy for any observer to recognize that an animal is lame, provided the lameness is at all decided, but there are many cases where the lameness is so very slight that it is difficult for an expert to locate it or even be sure that the animal is lame.

Side. — A very common error is that of locating the lameness on the wrong side. This is easily avoided if one remembers that the head and weight of the body in general come down most noticeably with the sound limb. For instance, a horse being lame in the left front leg will drop very evidently as he lands upon the right front leg.

Gait. — Some forms of lameness are detected with great difficulty when the animal is walking, but are easily seen when the horse is trotting. It is usually conceded that the latter is the best gait for diagnostic purposes, although the observer should study the movements at both walk and trot if possible. The pacing gait is rather confusing.

The test. — The animal should be tried on both hard and soft ground, and on side hill. If the lameness is in the foot, the lameness is most marked when the animal travels on hard ground. On the contrary, when a horse is lame in the shoulder, he is apt to travel with great difficulty in deep mud or in snow.

General examination. — The horse should be examined unblanketed in the stall, making him step from side to

side, and noting how he stands at rest. Then the horse should be taken out and observed while walking and trotting, coming toward, passing by, and going from the observer, the latter observing carefully the movements of the entire body and the use of each limb. It is especially important to observe head and hips in solving the first problem of locating the diseased limb.

It should always be borne in mind that the front foot is an especially common seat of lameness.

FROM BONE DISEASES

Bony growths. — Splints, spavins, ringbones, etc., are simply developments of bone tissue, the result of an inflammation of the periosteum. These are all recognized as

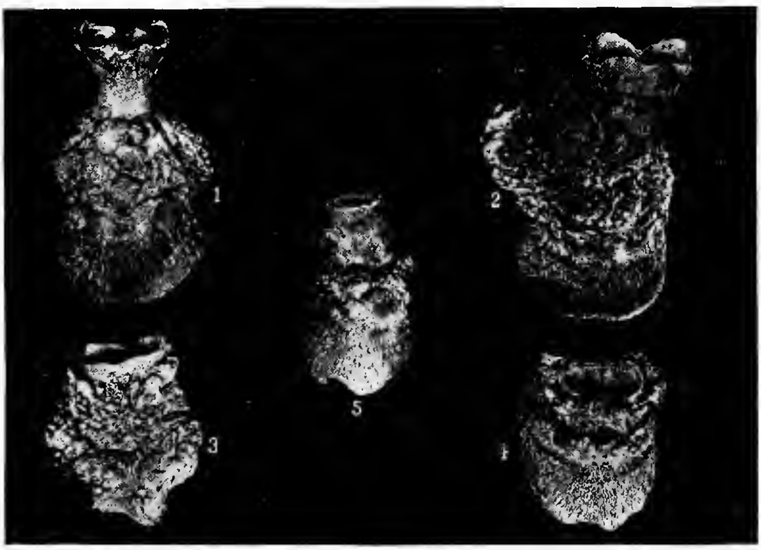

FIG. 77. — RINGBONES. (*M. H. R.*)

1. Ringbone and sidebone, with general anchylosis.
2. Ringbone and sidebone, with general anchylosis and marked bony enlargement.
3. High ringbone with anchylosis on first and second phalanges.
4. Low ringbone with sidebone, and anchylosis of the second and third phalanges.
5. Ringbone with sidebone, and unilateral anchylosis.

forms of unsoundness, and usually cause lameness. This inflammation may have its origin in bruises or other injuries, or possibly the inflammation in this tissue may be the result of an extending inflammation from some adjoining tissue, but in any case the result is usually a projecting development of bony tissue.

Splints. — These appear as small tumors along the metacarpal bones, usually at the junction of the large and small metacarpals. They may be of various shapes and sizes, but are usually small. They are generally more serious when located near the knee. Occasionally there appears what is known as a pegged splint, in which the growth extends across the back of the cannon, beneath the suspensory ligament.

The *lameness* which results from splints is rather easily recognized, first, by locating the splint, noting the sensitiveness on pressure over this point. A peculiarity of the lameness is that the horse walks nearly or quite sound, but trots very lame, especially on hard ground.

There is a natural tendency to recover. Lameness from splints is rarely seen in aged horses for this reason.

When the splint appears very close to the knee, or in the pegged form, there is less prospect of natural recovery, and with the latter form lameness is very apt to be permanent, unless relieved by surgical means.

Ringbone. — This is characterized by enlargement of some portion of the pastern bones. It may be in front, behind, on either side, or extending entirely around this region. It may be located near the crown of the hoof or very much higher, and we thus have ringbone divided artificially into two classes, high and low.

Ringbones are very much more serious forms of unsoundness than splints, as they are more apt to be permanent in effect, and even if the soreness be relieved, there is liable to be a mechanical lameness because of a stiffened joint. This unsoundness and the lameness resulting from it are very easily detected.

Sidebones. — Sidebone is an abnormal condition of the lateral cartilages, characterized by a firmness under pressure of these cartilages — which should be quite elastic. The firmness is due primarily to a deposit of lime in the cartilage structure. Sidebones are detected as bonelike structures which appear above the crown of the hoof and just beneath the skin on either side. They may cause lameness during the period of inflammation and hardening. In some cases the lameness is persistent.

Spavin. — The cause of lameness which we recognize under the name of bone spavin is an abnormal condition of the tarsal bones at the lower, inner, front portion of the hock. There is usually something of an enlargement, varying from a very small growth, commonly called by horsemen a jack, to a very large growth which every one recognizes as bone spavin.

There is another form of bone spavin in which there is a slight or possibly no external development at all. In this form of spavin there may be diseases of the bones in the deeper parts; particularly erosions of the articular cartilages. Bone spavins have a tendency to recover without treatment, although in many cases the period required for natural recovery is very long, extending through a period of years. In other cases recovery can never occur. Recovery when brought about by natural or artificial conditions implies that certain of the tarsal bones have united in the process called, technically, anchylosis, and the inflamed surfaces are no longer rubbing together as the limb moves.

Many bone spavins doubtless appear as the result of slight injuries in susceptible subjects, particularly those that have a strong hereditary tendency to diseases of this kind.

Bone spavin is one of the most serious forms of unsoundness of the organs of locomotion.

Symptoms. — A spavined horse steps on the toe, and carries the hock joint with as little movement as possible. The lameness usually disappears or at least greatly improves with exercise.

What is known as the *hock test* is made by holding up the limb, with the hock sharply bent, for several minutes. Then the horse is started suddenly. In case of spavin the

FIG. 78.—SIDEBONES. (*M. H. R.*)

Due to an inflammation and ossification of the lateral cartilages: 1, normal os pedis; 2, 3, 4, varying types of sidebones.

first few steps are very lame. Old horses without spavin may respond to this test and lead to error if one is not careful.

FROM SYNOVIAL MEMBRANES

Synovial sacs. — The ordinary wind puffs of the ankle, and bog spavins and thoroughpins at the hock, are typical illustrations of enlarged synovial sacs. They are not usually the cause of lameness, but are to be regarded rather as symptoms.

Wind puffs usually indicate considerable amount of hard road work.

Bog spavins. — These are enlargements of the synovial sac of the hock joint, and appear at the inner and front part of the hock. They are often hereditary.

Thoroughpins are very similar to bog spavins and wind puffs, except in location. Thoroughpins appear at the upper and back part of the hock. They may or may not connect with the synovial sac of the hock joint.

Open joint. — Lameness from open joint is quite common among city horses. This usually results from punctures of the synovial sacs and the entrance of foreign matter, resulting in an acute inflammation or synovitis. This form of lameness can usually be very easily detected, and the

cause recognized. It is very serious under all circumstances, and frequently results in loss of the animal.

Curb. — This is a result of an injury or strain at the back of the hock joint, and is characterized at first by a hot, sensitive swelling just back of the lowest part of the hock joint. After the period of swelling and inflammation subsides, there is apt to remain a hard tumor, particularly on what is known as curby hocks. In cases of young animals given proper treatment the remaining enlargement may be very slight or may practically disappear.

Capped hock. — Capped hock is not usually a cause or condition of lameness; but is mentioned at this place for other reasons. This is an unusual prominence at the point of the hock, and produced by bruises. Some horses get it by backing up against the stalls and striking so as to injure the point of the hock. Other cases are produced in car shipments. In other cases there seems to be a natural tendency, and the disorder is brought about by very slight injuries. The first swelling may usually be reduced by prompt treatment, but it returns with very slight injury, and after several attacks is apt to be permanent. This does not injure horses for actual use, but is unsightly, and materially reduces the sale value.

Shoe boil. — This appears as an enlargement in the point of the elbow or superior extremity of the ulna. It is very similar to capped hock in cause, character, and subsequent history. Shoe boils are unsightly and injure sale, but do not cause lameness.

LECTURE L

SOUNDNESS

If at any time a horse has any disease which either actually does make him less capable of his proper work, or which in its ordinary progress will diminish the natural usefulness of the animal, this is unsoundness.

Unsoundness. — The above is a very comprehensive definition, but soundness is usually relative, rarely if ever absolute or perfect. What we mean in passing a horse as sound, is that he is practically sound.

Definition. — To be theoretically sound a horse must have no disease or other condition that interferes or is likely to interfere with his usefulness, or injure his selling value. For instance, a horse may have a spavin which both lessens his ability to work and injures his selling value. The same would be true of heaves. A horse may have a disease from which he will recover. At the time of the examination he will be technically unsound.

Unsoundness may be temporary or permanent. Temporary unsoundness may be illustrated by an influenza, from which a horse would probably recover, or light sprains, or a bruised ankle — from interfering. In the latter case the question would arise at once as to whether the interfering was due to faulty conformation or to faulty shoeing, for the latter could be easily remedied. In the former case the condition would be serious; in the latter condition it would be unimportant.

Normal conditions. — It is necessary first of all to get familiar with the usual normal and unusual normal conditions and appearances for comparison. For instance, the hocks may be perfectly sound, and yet have peculiar bony

development. In such cases it will generally be found that both hocks are alike. The knees may have similar peculiar development, and yet be perfectly sound.

PRACTICAL EXERCISE

Examination. — An examination for soundness should be systematic and thorough, although it may be rapidly done. Examination should be made with a horse in the stall; as he backs out, stands at rest and in motion. In the stall

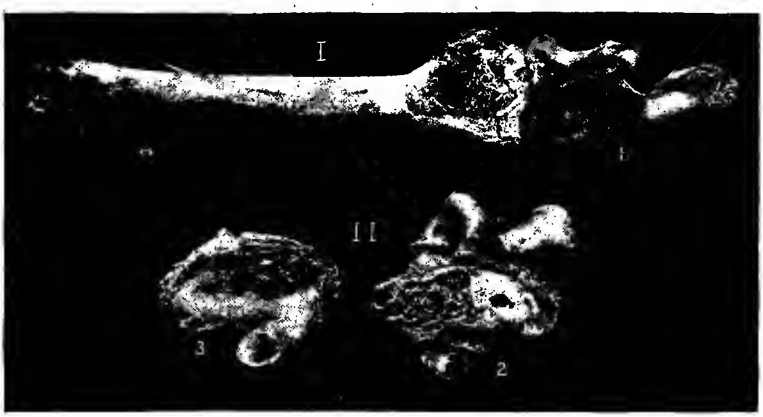

FIG. 79.—SPAVINS. TWO TYPES. (*M. H. R.*)

I. Spavin with marked bony enlargement. A, metatarsals; B, tarsals with enlargement and anchylosis.

II. Blind spavin. Extensive ulceration of articular surfaces; no enlargement; no anchylosis. 2, os calcis; 3, scaphoid or large cuneiform.

examine to see whether the horse cribs or weaves, or has any other stable habit which is objectionable. As the horse backs out of the stall, he may show peculiar use of the hind legs or imperfect control, due to serious disorders of the nervous system. Very frequently the first intimation of spavin may be had as the horse is made to step from side to side, particularly as he steps toward the spavined leg.

At rest. — With the horse at rest the observer should begin in front and examine the *ears* for hearing, for tumors that may develop around the base, for split ears, etc.

The *eyes* should be examined to test the sight, bearing in mind that moon blindness, which recurs at intervals and leaves the eye more or less nearly normal between times, still shows a weakened or squinting appearance that is suggestive. Bear in mind also amaurosis, which may leave the eye blind, but quite natural in appearance.

The *nasal chambers* should be examined for ulcers, scars, or discharges which would suggest possible glanders, bearing in mind that dishonest dealers sometimes plug the nostrils with a sponge to prevent the appearance of suspicious discharge.

The *teeth* should be examined for evidences of cribbing, for age, and for a condition commonly known as parrot mouth, which interferes with a horse feeding in pasture, *i.e.* overhanging upper jaw teeth.

The *lips* should be examined for evidence of paralysis. The *glands* under or rather between the portions of the lower jaw should be examined particularly with reference to glanders. See Glanders.

The *poll* should be examined for scars or other evidences of present or previous poll-evil.

The *withers* should be examined for scars, for discharging sores, and other evidences of fistulous withers.

The *shoulders* should be examined for sore neck and particularly so-called collar boils. The latter are either flat and broad or more prominent tumors, which will usually subject a horse to sore shoulders whenever he is put to work.

The *elbow* should be examined for shoe boil; the *knee* for scars or what is commonly known as broken knee, which indicates that the horse is inclined to stumble, and also for what is known as knee spavin.

The *cannon* or shin bones must be examined for splints, and behind them the tendons must be examined for evidences of sprains and other injuries which are usually indicated by a thickening of the parts.

Ankles are to be examined for evidences of interfering, and fractures or other injuries of the sesamoid bones and

attached ligaments. The region of the *pastern* is to be examined for ringbones, sidebones, fractures, and evidences of the operation known as nerving. Evidences of this operation are found in scars about midway of the pastern on each side, just at the edge of the back tendon. The sides of the back tendons should also be examined just above the ankle for scars, which would suggest another nerving operation. The mere fact that a horse has been nerved, whether going sound at the time of examination or not, is a very serious objection. This operation is not usually resorted to except as a measure of last resort, and it does not in any sense cure the original disease.

While passing along the side and flank the *breathing* should be observed, as to whether it is even and regular, or jerky, suggesting heaves. The flank and lower part of the abdomen must be examined for possible ruptures.

Stepping behind the horse, the two *hips* are compared for evidences of fractures, or what is commonly known as hipped or hip shot. This disorder does not interfere seriously with the horse's working ability, but gives the horse a very awkward appearance and materially lessens the selling value.

The *hocks* must be examined for bog and bone spavins, thoroughpins, and curbs, and the point of the hock for what is known as capped hock. The same examination is made of the cannon, ankle, and pastern as for the front limbs.

The *feet* should all be examined for evidences of contraction at the heels, for flatness or convexity of the sole, founder, navicular disease, and other diseases of the feet which are easily recognized. Among these should be named quarter and toe cracks, and serious injuries to the crown of the hoof by sharp calks.

In motion. — The horse should be examined while walking and trotting. The movements of the neck and head are studied as he comes toward the observer; then, as he passes by, the movements of the limbs are noted as to the height

to which they are raised; the bend of the joints, whether easy and natural or otherwise. The way in which the foot lands upon the ground, whether flat, on the toe, one side, or on the heel, is to be noted and considered. As the horse passes from the observer the movements of the hips and hind legs are noted with a view to detecting lameness in those parts. Examination in motion on hard road or

Fig. 80. Navicular Disease. (*M. H. R.*)

1. Normal navicular bone.
2. Exostosis (bony enlargement) with fracture.
3. Exostosis with extensive ulceration of the articular surface.

4, 5, 6, 7. Varying types of exostosis.

pavement should be made, especially to bring out diseases of the feet. Then motion in deep mud or in snow should be studied. If these are not available, the horse should be made to step over a rail or plank held up about a foot from the ground in order to detect or make more prominent possible soreness or lameness in the shoulder or hip.

The lungs. — Finally, the horse should be given vigorous exercise on a full stomach. For instance, a run to a heavy wagon, or a short run uphill to determine whether the lungs are normal, or, in other words, for the purpose of testing his wind. It is possible to partially disguise abnormal breathing while a horse is at rest, but it is practically impossible to do so if the horse is given violent exercise, and

the latter should preferably be done after feeding and watering.

SUMMARY

The most common and obvious forms of unsoundness are: Bad eyes; glanders shown at the nose; poll-evil, just back of the ears, at the top of the neck; fistula at the withers; heaves, shown in breathing; splints, along the cannon; injured tendons; farcy sores on limbs or body; bruised ankles from interfering; sidebone and ringbones at the pastern; navicular disease, corns, founder, cracks, etc., at the foot; fractured hip (hipshot); spavin at the hock in front, and curb at the hock behind.

LECTURE LI

COMMON DISEASES OF SWINE

RHEUMATISM

THIS disease is rather common in swine, and affects either the muscles or joints.

Cause. — Frequently due to cold, damp quarters, and yet cases of rheumatism appear under the most favorable conditions. It is not thought best to discuss the physiological chemistry involved, in view of the uncertainty which still exists.

Symptoms. — Affected animals are lame and sore. The exact symptoms depend of course upon the location. Very frequently the ankle joints are swollen and very tender. There is a rise of temperature in the acute cases. Food is refused and movements are very painful. This disease in swine, as in other animals, exhibits a tendency to move about from one limb or from one joint to another.

Treatment. — Physic freely; *e.g.* for a hog weighing 150–200 pounds give 2 ounces Epsom salts or 2 ounces castor oil, or 2 compound cathartic pills. Give 15 drops oil of gaultheria in $\frac{1}{2}$ ounce of bland oil, like linseed oil or sweet oil. Give also potassium iodide in 10-grain doses 3 times a day, either in water or feed. For local effect apply over the joints the following liniment: 8 oz. tincture belladonna, 1 oz. tincture opium, and 1 oz. fluid extract aconite. This treatment should be applied freely on flannel cloths rung out of hot water dry as possible. For swollen joints that are not especially painful a blister gives more satisfactory results.

POSTERIOR PARALYSIS

This is a rather common and serious disease affecting especially swine and involving the hind quarters. In most cases it is probably a disorder of either the spinal cord or the spinal nerves.

Causes. — Fracture of the thigh bone sometimes occurs in connection with rachitis (rickets), and is mistaken for paralysis. Rachitis, a disease of the bones, may appear, like paralysis, in growing swine. Some cases are due to injury of the spinal cord. This disease often appears in heavy hogs after shipment by rail. Other cases are due to slow organic disease of the spinal cord. The direct cause of those cases which depend upon organic diseases of the cord or spinal nerves is not known. A common type develops suddenly in old and heavy swine, particularly those in high flesh, and is due to simple constipation.

Symptoms. — Some cases develop suddenly; others develop gradually during several days and even weeks. The cases which develop slowly show at first irregular gait behind. The hind legs may cross in walking; there is difficulty in rising and general lack of control for the hind legs.

If the case develops suddenly, there is inability to use the hind limbs, which are limp and weak, not unlike affected limbs of horses having azoturia. Hogs affected with this disease usually retain good appetite, and are lively aside from the posterior paralysis. They are apparently in good health for weeks, having perfect control of the front limbs. If they move at all, the hind limbs are simply dragged. This trouble is easily distinguished from rheumatism in most cases by absence of pain.

Treatment. — A decided physic, 10 to 20 grains of calomel in a small piece of pork; or 2 oz. castor oil with 2 drops of croton oil, well mixed. If the case is persistent and the animal valuable, then potassium iodide should be given in 10-grain doses 3 times a day, either as a drench or in the drink. Turpentine should be applied over the loins until the skin becomes sore.

CONGESTION OF THE LUNGS

This is a rather common affliction and very apt to be fatal. It is simply an engorgement of the pulmonary blood vessels (hyperæmia).

Cause. — Active exercise of swine in high flesh.

Symptoms. — These cases are usually acute and apt to end fatally. The symptoms are those of suffocation. There is marked distress; respiration is very rapid, even the mouth being held open in an effort to get air. The pulse is very rapid and weak, and the animal is apt to fall suddenly.

On examination post mortem the pulmonary vessels are engorged and the lungs are dark. There is no definite exudate which distinguishes this from pneumonia, pneumonia being an inflammation of the lung tissues.

Treatment. — Stimulant: Use aromatic spirits ammonia 1 dram, alcohol 4 drams, in water, repeated at short intervals; for example, 15 minutes to one half hour. The animal must be kept warm and the extremities rubbed vigorously.

CONSTIPATION IN SWINE

Constipation is a rather frequent cause of trouble among swine. Mature hogs become easily affected when unwisely fed and limited as to exercise.

Cause. — This trouble is very frequently associated with high feeding and lack of exercise. This is especially true when the food is dry and lacking in laxative material. Hogs are rarely affected by this when on grass or clover or when receiving roots or pumpkins or other fresh vegetables in the feeding yards.

Symptoms. — The affected hog is restless, and occasionally strains as though trying to pass manure. The manure is hard and frequently covered with mucus. The hog becomes dull and loses appetite.

Treatment. — Give 1 to 3 ounces of castor oil, depending on the size of the hog, or as a substitute for the oil give

Epsom salts, in 1 to 3 ounce doses dissolved in warm water and administered as a drench. One to 3 drops of croton oil may be added to the castor oil in unusual cases. For mild cases of simple constipation old-fashioned senna tea, coupled with rectal injections of warm water, is usually very satisfactory. It is necessary to exercise great caution in giving liquid medicine to hogs on account of the danger of suffocation caused by drawing liquid into the lungs while squealing.

A very simple way is to cut a hole in the toe of an old shoe; insert the toe into the mouth, and allow the hog to chew it while the medicine is poured in slowly and carefully. A short piece of ordinary garden hose with a funnel inserted at one end is also very satisfactory for this purpose.

After relief has been secured by medicine, then the recurrence of this trouble should be prevented in the future by wiser feeding and abundant exercise.

QUINSY

Symptoms. — There is a marked sore throat. The neck is swollen back of and beneath the lower jaw. There is difficult respiration. Prognosis is usually favorable.

Treatment. — Hot fomentations around the swollen neck, and the following prescription may be given internally: Fluid extract belladonna 20 drops, chlorate of potash 10 grains, 3 times a day in 2 oz. water.

SUGGESTIONS

Drenching swine. — Put a piece of rubber hose on the neck of bottle, give medicine slowly and cautiously, and if possible when the animal is not squealing. The animal may either be thrown down and held, or tied, or a loop may be passed around the upper jaw back of the front teeth and held by a turn around a post; but in this case, medicines must be given with great care.

Black teeth. — Black teeth in young pigs are not of serious importance, so far as the teeth are concerned.

LECTURE LII

OBSTETRICS

OBSTETRICS is the science which deals with the birth of young animals.

The female organs studied in obstetrics are: ovaries, Fallopian tubes, vagina, and uterus.

Ovaries. — These are two small, more or less flattened, spherical organs, suspended in the front part of the broad ligament (see uterus) in the sublumbar region. In the cow and mare they are about the size of hulled walnuts. Their function is to develop, mature, and discharge the ovules or eggs.

Fallopian tubes. — Two slender tubes connect the ovaries, one on each side, with the horns of the uterus. Ovules or eggs pass through these tubes on their way to the uterus.

Uterus (*womb*). — The uterus is a muscular and membranous sack, very large in pregnant animals, located partly in the pelvic cavity and partly in the abdominal cavity.

Structure. — The womb consists of three layers or coats: (*a*) outer or peritoneal; (*b*) middle, muscular; (*c*) inner, mucous.

The outer coat (*a*) is the thin, delicate, glistening membrane, peritoneum, which lines the entire abdominal cavity and covers with another layer every organ within that cavity.

The middle coat (*b*) is composed of two distinct sets of muscle fibers. The outer fibers extend lengthwise, and the inner ones around the uterus. The muscular coat gives strength and support to the womb and aids in expelling the fetus at birth.

The inner coat (c) is a mucous membrane and very similar to that which lines the mouth and whole alimentary canal. This coat has especial physiological importance, since it provides for early nourishment of the ovum and later develops the maternal placenta. It is the placenta which gives the bond of union between the mother and fetus during pregnancy.

Shape. — The body of the uterus is cylindrical and divides in front into two branches. Each branch connects with a Fallopian tube and through that with the ovary. The body of the uterus narrows behind to a neck which projects into the vagina. The rectum is above the uterus, and the bladder below it.

Supports. — The uterus is held in place by four ligaments which are mainly folds of the peritoneum. The most important of these are the broad ligaments. These are two wide folds of the peritoneum which extend the whole length of the body of the uterus and its horns, one on each side. They attach in the sublumbar region above, and to the sides of the uterus below. A third ligament attaches above to the rectum, and a fourth below to the floor of the pelvis. These four ligaments all give support to the uterus and hold it in position.

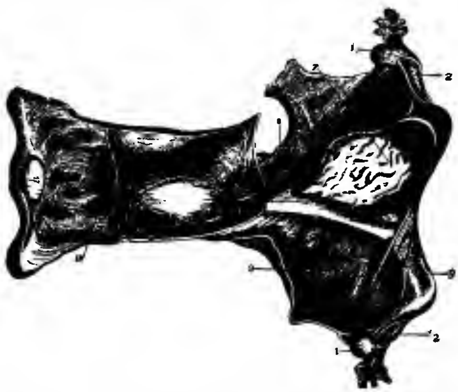

FIG. 81.—GENERATIVE ORGANS OF THE MARE.
1, ovaries; 2, Fallopian tubes; 6, horn of uterus intact; 7, horn of uterus laid open; 8, body of uterus; 9, broad ligament; 10, cervix or neck of the uterus; 13, outlet of the urethra.

Openings. — There are three openings into the uterus: one behind into the vagina; two in front for the Fallopian tubes.

Function. — The function of the uterus is to receive and

nourish the ovum and mature it after it has been fertilized.

The ovum attaches to the uterine wall; a covering and supporting membrane is developed around it; and there the fetus develops, receiving a rich supply of oxygen and food materials from the maternal uterine walls, through the surrounding membranes, by osmosis.

Vagina. — This is a membranous tube which contains much muscular tissue in its walls.

Structure. — There are three coats: (*a*) outer of loose connective tissue; (*b*) middle, muscular; (*c*) inner, mucous.

Location. — The vagina is located in the pelvis between the rectum above and the floor of the pelvis below. It is capable of great dilation to allow the passage of the young at birth. Between the uterus and vagina the connection or common opening is through the neck, at which point the uterus narrows greatly and is composed of firmer tissue. As the time for delivery approaches, this narrow canal dilates until the opening is large enough for the young animal to pass through.

Normal period of gestation. — This varies from two years in the elephant to 28 days in the rabbit. The cow carries young 283 days; mare, 345 days; sow, 119 days; ewe, 149 days. All these may vary greatly. Old animals usually carry longer than young.

ACCIDENTS OF PREGNANCY

Most important. — The most serious are: (*a*) abortion; (*b*) retention of the fetus; (*c*) volvulus (twist in the neck of the uterus).

(*a*) **Abortion.** — For the purpose of this lesson, abortion may be defined as any premature birth.

They are either (1) sporadic or (2) infectious.

(1) *Sporadic abortions* may be due to a great variety of conditions; *e.g.* sudden change in the weather and exposure to cold; strong medicines, especially purgatives; mechanical injuries; sudden and unaccustomed exercise; extreme

nervous excitement; diseases accompanied by cough or severe pain or high fever; ergot, smut, etc., on the food; water containing sewage; disease of the uterus; lack of constitutional vigor in either sire or dam.

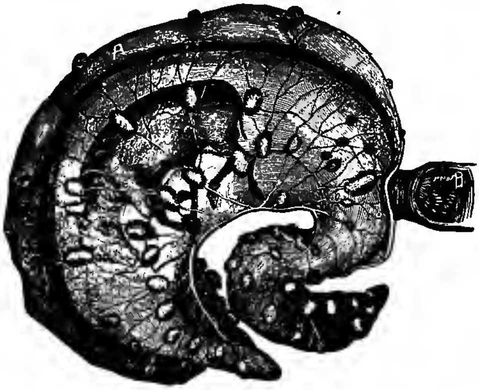

FIG. 82.—FETUS AND FETAL MEMBRANES OF THE COW AT MID-PREGNANCY.

Uterus opened on the right side, exposing fetus and membranes. Note the small, light-colored bodies (cotyledons) which connect uterus and membranes. See also Fig. 83. A, uterus; B, cervix (neck of uterus).

(2) *Infectious abortion* is probably due to a distinct contagium; *i.e.* to the action of living germs upon the uterus and placental membranes. Certain conditions of the atmosphere, diet, and vitality may favor the outbreak.

Infectious abortion does not spread rapidly through a herd, but the cases come at intervals throughout the season of pregnancy until a large percentage of the herd may have aborted.

Preventive treatment. — In case of sporadic abortion, the uterus can sometimes be quieted and a threatened abortion prevented by the early administration of tincture of opium and f. e. viburnum given as follows: —

	Cow or Mare	Sheep
Tinc. opium	2 oz.	2 drams
F. E. viburnum prunifolium . .	3 oz.	3 drams
Sirup	10 oz.	2 oz.

Repeat every two hours until the patient is quiet or the abortion occurs, and keep the cow under the influence of these medicines for several days, greatly reducing the opium

as soon as the urgent symptoms have passed. Small and frequently repeated doses of oil may be needed to prevent and overcome the constipating effect of opium.

General prevention. — When a case of abortion occurs in any herd or flock, begin a search for the cause. If this cause continues in operation, a large number of animals may become affected. The animal that has already aborted should be removed at once from the shed or stable where others are confined. All fetal membranes and discharges from the vagina must be burned or buried, and the stall where the abortion occurred should be disinfected with 5 per cent crude carbolic acid. A special attendant should take care of animals that have aborted, if there is any possibility that they have had the infectious type of this disease.

Symptoms. — Symptoms of approaching abortion are frequently obscure. Sometimes there is a discharge from the vagina. This organ is swollen and the mucous membrane may be deeply congested. Slight labor pains sometimes appear several hours before the fetus is expelled and before the sac is ruptured. Occasionally the animal may be noticed moving around uneasily. Ligaments at the tail head on each side relax and drop. The udder develops prematurely, especially noticed in heifers.

General results of abortion. — The afterbirth is frequently retained and slow blood poisoning may ensue in the absence of skillful treatment. Garget may appear, which seems to be associated with the condition of the uterus, probably by transfer of infection from the discharge. The appetite is impaired or lost. The patient loses flesh and gets very weak and thin and may come in heat frequently, but does not become pregnant again for a long time, or remains barren.

LECTURE LIII

INFECTIOUS ABORTION

Causes. — It seems very probable that infectious abortion is due to living microörganisms, *i.e.* to bacteria. It is very possible that several different germs are capable of causing this disease. If this be true, then we do not have a specific disease due to a specific germ.

Dissemination. — It is evident that this disease may be spread in many ways. The afterbirth, discharges from the womb and vagina, and manure of very young calves are probably all infectious. The disease may be transmitted directly at the time of service from male to female. It is conceivable that a cow which has aborted and whose tail is contaminated with discharge might very easily infect another cow by simply switching her tail so as to strike the hind quarters of an adjoining cow.

A cow may abort one or more times, then become immune and carry her future calves to full term, but remain infectious for an indefinite period, and thus prove a very serious, because unsuspected, source of spread. There are many cases on record where the disease has been introduced into a sound herd by a bull from a diseased herd or by a home bull which has been allowed to serve infected cows in other herds. This disease is easily introduced by the purchase of an infected cow from a herd in which the disease has prevailed. In this case the disease would ordinarily spread from the infected cow to the herd bull and from the herd bull to the previously healthy cows of the home herd.

Method of infection. — There are probably various methods of infection. Infecting material may reach the genital organs of the healthy female. There is some evidence that the disease may be contracted through food and by inoculation, *i.e.* in cuts or abrasions of the skin. The disease appears to have been transmitted experimentally by artificial inoculation into veins.

Effect. — A serious percentage of cows which abort subsequently become sterile. Most cows do not abort more than twice and thereafter become immune, producing healthy calves at full term, but remaining infectious. Contamination with the virus of abortion may result in direct abortion, or the calf may die and become mummified, or be born at or near full term weak and predisposed to diarrhea. Cows which abort are very apt to be unthrifty for a very long time. Many of them contract infection of the udder, probably from vaginal discharge, leading to a serious garget, and there may be a condition of general septicæmia or blood poisoning.

Diagnosis. — We have first the history of an unusual number of cows in a herd dropping their calves prematurely. Frequently the vaginal discharge which accompanies abortion is dirty in appearance and of a foul odor. The mucous membrane of the vagina frequently becomes congested and the lips of the vulva swollen several days before abortion occurs. A tendency to abortion, especially in heifers, is usually indicated by marked premature development of the udder, and the ligaments at the tail head on each side relax and drop.

Prevention. — It is necessary to bear in mind the probable cause of this disease and the common methods of dissemination. A farmer owning a healthy herd should, for instance, never purchase cattle of breeding age from a herd in which this disease has occurred within three years. He should not do public service with a herd bull where there is possibility of contamination, nor should he use a neighbor's bull that can possibly be contaminated with this infection.

Management of an aborting herd. — Abortion should not be allowed to occur in the herd stable if it can be avoided. The calf and afterbirth should be buried deeply or, better still, be burned. Floors and partitions and other contaminated surfaces should be carefully disinfected. In case the calf is mature enough to survive, its manure should be treated as though it were certainly infectious.

Some outbreaks of what seems to be infectious abortion are apparently gotten rid of very easily under treatment which would not appeal to an experienced veterinarian or bacteriologist as amounting to anything; but as a rule very painstaking work, long continued, is essential to any assurance of success. An owner should not undertake the treatment of a considerable number of animals unless they are sufficiently valuable to make it worth while, nor without realizing that he has a hard task ahead of him. The general method here recommended for eradication of infection is based on present information. It is quite likely that we shall have much additional light on this disease within a few years which will enable us to change and simplify very much our methods.

Divide the herd into two groups; namely, cattle to keep in the herd, and cattle that should be sold for slaughter. Sell all females that have ever been bred and which are not valuable enough to justify a large amount of work and some expense. Cows that have ever aborted and bulls that have served such cows should be sold only for slaughter.

Non-pregnant females over one year of age which have not recently aborted should have one internal disinfection (*a*) and one external disinfection (*b*) daily for four weeks, and thereafter twice a week for four weeks more.

Pregnant cows should be disinfected internally once a week until within a month of calving. Disinfect these externally twice a week until they calve, and give carbolic acid internally.

Cows that have *recently aborted* should have the womb irrigated, using a gallon or more of warm solution daily for

a week; thereafter once a week as long as the womb remains sufficiently open. For this irrigation use internal disinfecting solution (*a*) injected directly into the womb. This is for all cows that have aborted and are to be saved for breeding. The afterbirth and all discharge must be deeply buried or burned.

When a cow has aborted, the afterbirth should be removed within 48 hours if it will come away easily. If it does not come away easily, then irrigate the uterus freely with a warm internal disinfection (*a*) twice daily until it does come away. After this, continue irrigation in retained afterbirth cases once a day as long as the opening of the womb permits. Cows that have aborted should not be bred in less than three months, and in no case until the discharge has ceased for at least a month.

Males should be used with great caution. For cows that have never aborted use a bull that has had no chance for infection, the bull to be disinfected internally before and after each service; use a different bull for cows that have aborted, he also to be disinfected internally before and after service, but with a different piece of tubing and nozzle. Bulls known to be infected should be irrigated once daily for four weeks, and after this period before and after each service.

DISINFECTION

Internal disinfection (*a*) as used here (except where reference is made to womb of cows that have recently aborted) means injection into the vagina for females and into the sheath for males. External disinfection (*b*) for cows means around and under the tail and between the thighs. External disinfection for bulls means the outside of the sheath, especially around the opening.

For *internal disinfection* use .75 per cent lysol or creolin, warm. For very sensitive cows it is advisable to begin the internal disinfection at .25 per cent or even with plain water and increase gradually to the .75 per cent. A container and a few feet of ½-inch rubber tubing with a funnel

and a short smooth nozzle of some kind is all that is necessary for apparatus. A nozzle is not necessary if the tubing is fairly rigid. An ordinary horse stomach tube is a very satisfactory tubing for cows, and a horse catheter may be used with the best satisfaction for bulls in place of rubber tubing and nozzle. A simple container for gravity apparatus, very convenient and cheap, may be made from a large galvanized iron pail with a stopcock at the bottom. An old-fashioned "shotgun" milk can is an ideal container, since it is already fitted with stopcock at the bottom and has a glass gauge at the side where the amount given each animal may be easily read off as the fluid lowers in the can. The container may be very conveniently held by an ordinary snap sliding on an overhead wire extending across the stable back of the cows.

For *external disinfection* use lysol or creolin 3 per cent, or corrosive sublimate 1 to 1000, or carbolic acid 5 per cent, in water.

Stables. — Manure should be removed and used so that it cannot carry infection to pregnant cows. Feed for cows that are pregnant or about to become pregnant must not be contaminated by discharges from aborting cows, or by manure from calves born of aborting cows when the calves may be mature enough to live.

For *disinfection*, the cow stable should have litter cleaned out of the mangers and stalls; walls, partition, floors, etc., should be scrubbed by means of a broom and plenty of water and be then disinfected by means of corrosive sublimate, 1 to 1000 in water, or copper sulphate, 5 oz. to a gallon of water, or, better still, by corrosive sublimate in fresh whitewash in the proportion of 1 lb. corrosive sublimate to 1000 lbs. of water (125 gallons).

MEDICAL TREATMENT

All pregnant cows in an aborting herd should have carbolic acid mixed with ground feed. Large doses of carbolic acid continued for a long time have seemed to give the writer good results in aborting herds and in some cases

where abortion seemed actually threatened. Begin with one dram of carbolic acid per day per 1000 lbs. weight. Dissolve the acid in 4 oz. of water and thoroughly mix it with feed to avoid burning the mouth. Increase this dose in about 10 days gradually to 4 or even 6 drams a day in a pint or pint and a half of water, giving the larger dose in 2 or 3 feeds. Continue this for a month. Thereafter give this dose (4 to 6 drams) daily for 10 consecutive days each month until the cow calves, and make the treatment periods regular. There should be not less than one pound feed (dry) to each dram carbolic acid.

In order to avoid having cows in full flow of milk refuse a feed or two while they are getting accustomed to the acid, it is worth while to begin with a much smaller dose than indicated. After cattle become accustomed to carbolic acid, they apparently do not dislike it, but rather like the flavor.

In our experimental work we have given very large quantities of carbolic acid without apparent harm, much larger quantities than the doses here recommended.

It is very convenient for this treatment to make up 3 per cent solution carbolic acid in water; 4 oz. of solution contains one dram carbolic acid. In the summer time when cattle are on pasture, or at any time when it is advisable to cut down the grain ration to a point where the bulk would not be sufficient to properly dilute the acid, then this medicine may be easily given by drench.

It frequently occurs that in aborting herds there are a number of barren cows; some have aborted and thereafter remain sterile; others have been infected without abortion and subsequently remain sterile. Many of these cases can be induced to breed by suitable internal disinfection. Cows in an aborting herd that fail to breed should be disinfected internally (*a*) once daily for a month and thereafter twice a week until they are safely in calf. In case a cow is to be served within 10 or 12 hours after receiving internal disinfection, the vagina should first be flushed out freely with warm water or warm water with a little soda.

LECTURE LIV

OBSTETRICS

ACCIDENTS OF PREGNANCY

(*b*) **Retention of the fetus.** — This trouble is most common in cows. The period of retention may vary from normal up to five years. A fetus may be alive in the cow for at least a year from pregnancy, it may be dead and mummified, or it may decompose. Aged mares sometimes carry far beyond the normal period for delivery and then give normal birth.

Symptoms. — The mother may show labor pains at normal time and all other symptoms of parturition may be present. The symptoms disappear and the cow goes on as if non-pregnant, but does not usually come in heat.

Causes. — Partial paralysis of the uterus; excessive adhesions between fetus and uterus; deformed pelvis; torsion of uterus, etc.

Treatment. — At normal period of delivery dilate the neck of the uterus with the aid of belladonna ointment and gentle mechanical force, and deliver the calf. If the cow has gone safely past this period, then fatten and sell her for beef.

(*c*) **Volvulus** (*or twist*). — A twist sometimes occurs in the neck of the uterus and makes delivery exceedingly difficult.

It is much more common in the cow than in the mare, and usually occurs near the termination of pregnancy.

Cause. — It may be caused by the patient slipping or falling, and especially if she rolls over, late in the period of pregnancy. Some authors think it may be due to active

and unusual movements of the fetus. It can only be diagnosed positively by examination with the hand and finding a twist in the neck of the uterus.

Treatment. — If the twist is slight, the operator may be able to reduce it by introducing the hand into the uterus and grasping some portion of the fetus and causing the uterus to unwind by a strong twisting motion. Sometimes it is necessary to throw the cow or mare, then introduce the hand, grasp firmly one or more limbs of the fetus, and have the cow rolled in the opposite direction from the twist, holding firmly to the fetus meanwhile. If the operator can succeed in getting his hand into the uterus, and especially if he can get one or more fetal limbs through the neck of the uterus, the twist may usually be reduced. Some of these cases, however, are exceedingly difficult to handle.

ACCIDENTS OF PARTURITION

The most common are: (*a*) germ infection; (*b*) inversion of the uterus; (*c*) tear in the vagina; (*d*) retention of fetal membranes; (*e*) hemorrhage; (*f*) mammitis (garget).

(*a*) **Germ infection** of the female genital organs may cause blood poisoning. When introducing the hand or any other foreign body, be sure that it has not recently touched what is dead or putrefying or otherwise infected.

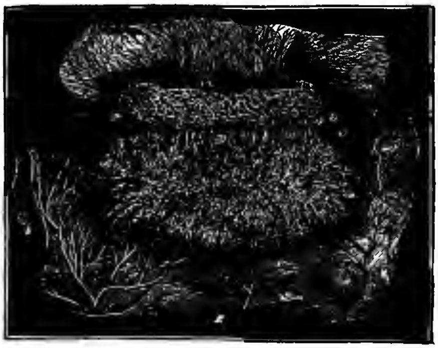

Fig. 83. — Bovine Cotyledons.

A, pedicle of uterine cotyledon; B, B, uterine cotyledon; D, fetal cotyledon; E, fetal membrane.

(*b*) **Inversion of the uterus.** — This is most common in the cow, and may be partial or complete. There may also be partial eversion of the bladder and vagina.

Causes. — This may be due to excessive force used in aiding delivery, or failure of the uterus to contract after delivery.

Treatment. — Thoroughly cleanse the protruding uterus with hot water and invert over the hand and arm. Be careful to smooth out each fold and leave the uterus in a natural position. If the uterus is greatly swollen and heavy, bathe in cold astringent solutions, like strong alum water, until the size is sufficiently reduced to permit replacement. A common washtub is very convenient for bathing the soiled and swollen uterus.

Bandaging very firmly with a wide roller of muslin forces out much of the blood, reduces the bulk, and allows handling of the uterus without injury. The bandage should be wide, and rolled from both ends.

To put on the bandage, begin with the middle of the bandage at the end of the uterus and carry the ends around in opposite directions, pulling firmly all the time so as to force the blood back into the general circulation. In very troublesome cases it may be advisable to first throw a cow carefully, then hoist her hind parts by pulleys and ropes until only the shoulders and neck rest upon the floor. The rope should be attached by hopples or otherwise just above the ankles, and suitable provision made so as to avoid injury to the skin and underlying parts. A good hopple strap will usually do very well. Ordinary rope could be used with several thicknesses of heavy cloth or a flat pad of oakum inside of the rope to protect the skin. In this position the uterus of a very troublesome case may usually be replaced easily, and no harm is done to the cow if she is carefully handled. After replacing, it is sometimes advisable to pack the uterus with cotton and close the outlet by means of sutures through the vulva, or to put on a rope truss.

Finally give the cow 3 oz. tincture of opium and 2 oz. bromide of potassium in $\frac{1}{2}$ pint of sirup. Give a mare two thirds of this dose and the ewe one eighth. Repeat

the dose in three hours if the animal is still straining. If necessary, apply rope truss as shown in classroom.

(*c*) **Tear in vagina.** — A vagina may be torn above or below by excessive size of the fetus, by faulty position of the fetus, or by excessive force used in delivery. This calls for immediate operation by a veterinarian, and the injury is much more dangerous for the mare than for the cow.

(*d*) **Retention of the afterbirth.** — This trouble is most common in cows, but is less serious for cows than for mares.

Cause. — Retention is much more common in cows than mares or other classes of stock. This trouble is caused by unusual adhesions between the placenta and the womb, and is probably due in most cases to mechanical imprisonment of the placental tufts in the corresponding cavities of maternal cotyledons.

There is normally a short period of exhaustion following delivery. After this period the uterus should soon recover its normal tone and expel the afterbirth and accompanying fluids. If the exhaustion period of the uterus and a condition of general debility be abnormal and therefore expulsion of the placenta (afterbirth) does not occur promptly, then infection followed by inflammation develops, and the incarceration and retention follow. Note the probable order of development: infection, inflammation with the accompanying swelling, and then adhesion.

Treatment. — For the mare the placenta should be removed within twelve hours if it fails to come away naturally.

For the cow it is better to examine soon after delivery. If the afterbirth can be removed easily and without hemorrhage, then the sooner it is removed, the better. If there is any reason to think infection is especially liable to occur, *e.g.*, from a dead fetus, or from injury in delivery, then it is usually wise to remove the afterbirth immediately.

Everything in this work must be done with a view to surgical cleanliness. First, irrigate the vagina with an antiseptic and disinfect the surrounding external parts.

Try to remove *all* placenta. As a rule it is wiser to not remove any placenta than to merely tear off the free portion of it.

Twist the membranes that appear outside; then introduce an oiled hand into the uterus and gently separate the placenta from its uterine adhesions, pulling with the other hand outside.

If a cow's afterbirth does not come away easily and completely and there be no urgent reason for removal, then the treatment should be directed against extension of infection. Free uterine and vaginal irrigations once a day are indicated. For this purpose, we may use .5 per cent creolin or .5 per cent warm lysol injected freely by means of a funnel and rubber tubing or otherwise. If the uterus does not expel the fluid, then it should be siphoned out.

A good authority (Williams) recommends iodoform after the irrrigation and expulsion of the fluid, and suggests that the iodoform may be inserted in a capsule and the capsule either left to dissolve or the capsule may be opened and the powder scattered by the hand. It would seem that this might be accomplished by a long nozzle powder blower. The purpose of this is, of course, to check the development of infective organisms during the periods between irrigation.

The patient should be examined from time to time, and it will usually be found after a number of irrigations with warm antiseptic that the inflammation has subsided and the afterbirth has been released and will come away easily. In some cases of retained afterbirth there develops a rapid necrosis (tissue death) of the maternal cotyledons, in which case the cotyledons themselves may come away quite easily with the afterbirth and their removal cause no additional harm and even be of benefit in such a case. This condition should also be followed by free antiseptic irrigation, as already suggested.

(*e*) **Hemorrhage.** — This is rare in the lower animals. It is denoted by rapidly increasing paleness around the eyes and in the mouth and by quick, feeble pulse. Blood may

not appear on the outside, and yet the bleeding be extensive. Give 3 oz. F. E. ergot at once, in 4 oz. sirup, and then give 1 oz. ergot in 2 oz. sirup every hour if necessary, up to a limit of six doses; meantime pour ice water over the back and loins.

GARGET

Garget is an inflammation of the gland tissue and other structures composing the udder. Some congestion and hardening of the udder is probably to be considered normal when it occurs at about the time of parturition.

Caues. — Garget proper (mammitis or mastitis), usually, and possibly always, is caused directly by germ infection. Germs probably gain entrance in most cases through the milk ducts of the teats. There is great variation in the severity of these cases. Some cases of garget are very mild, and some lead to rapid loss of the udder.

We believe that many cases of garget come as a result of infection from retained afterbirth, or from some purulent discharge from the vagina. The infection from a retained afterbirth or from the vaginal discharge becomes smeared upon the teat; some germs gain entrance into the milk canal, where they find favorable conditions for multiplication and rapid extension up the milk canal into the udder. Some cases receive their infection from the hands of milkers coming from other cows which have such infectious material upon the teats or the udder. Many cases of garget have their infection carried into the milk duct by milk tubes.

Symptoms. — The symptoms of garget are the usual symptoms of inflammation in any organs: *i.e.* pain, heat, redness, and swelling. This is one of the easiest of all diseases of live stock to recognize.

Results. — Garget usually leaves a damaged udder. In some cases the damage may be extreme and in other cases slight, but it is probable that few cases are ever restored completely to normal. The injury to the milk-gland

structure includes various tissue degenerations, hardening and permanent enlargement, abscess, or gangrene. Development of gangrene may be detected by noting that the part which has previously been hot and tender becomes cold, dark in color, and insensitive.

Prevention. — Cows that are wisely fed seem much less liable to udder troubles at the time of calving. Heavy milkers especially should not be heavily fed during the last period of pregnancy. The food should be laxative in character, and this same method of feeding should be continued until about the fourth day after calving, when the grain ration may be gradually increased, the cow being put on feed very gradually for several days more.

In case of a valuable cow that has just calved it is wise to disinfect the udder and teat with 1 to 1000 bichloride in water, which may be washed off with plain water if the calf is allowed to suck. If possible, this disinfection should be given before any milk is drawn after calving, and should be kept up for a week in case of a valuable cow. It seems that the cow's udder is most liable to this trouble during the first week or so after calving. After the milk flow is fully established and regular milking is done, there does not seem to be so much danger of garget.

Milk tubes do very much more harm than good as a rule, and should never be used except when absolutely necessary. Tubes should be used only after thorough disinfection of the teat and boiling of the tube. The latter must not be handled in any way so as to infect the portion which is to enter the teat. Care should be exercised about milking a cow with hands that have been contaminated from purulent discharges of any kind or with any kind of infectious material.

Milkers should clean their hands thoroughly for the sake of simple cleanliness and pure milk, if for no other reason, and in addition for the very good reason that they are liable to carry on their hands infection which may cause garget in the udder of valuable cows.

Treatment. — The diet throughout a case of garget should be light and laxative. Very light feeding during the last few weeks before calving is good preventive treatment in any case.

If the case threatens to be serious, give internally fluid extract of belladonna, 2 drams, with fluid extract of phytolacca, 1 ounce, four times a day in a little water. This may check considerably the milk flow and in this serve a useful purpose. Give also nitrate of potash (saltpeter), 2 ounces at a dose, with $\frac{1}{2}$ pound Epsom salts, three times a day, each dose dissolved in a quart of water.

For external treatment of the udder apply hot water freely for long periods of time; *e.g.* twice a day 2 or 3 hours at each treatment. The water should be used as hot as it can be borne, without injury to the skin, and should be used very freely. This hot-water treatment may be given to good advantage by putting a sling around the cow's body under the udder and in front of the hips to support the udder. Four holes may be cut for the teats, and woollen cloths or cotton or oakum should be packed around the udder inside of the sling to hold the heat and moisture. The hot water can then be poured in from above or be thrown against the packing from below by means of a small dipper. The point is to treat the udder with moist heat for a long period of time.

After each water treatment rub the udder dry and apply the following ointment: Belladonna extract, 2 parts; vaseline, 8 parts; melted together. As the mixture cools, add one part camphor. Long-continued moderate rubbing and handling of the udder is beneficial. This is best accomplished by a combined rubbing and gentle kneading action upon the udder with the hands. This massage, if not unreasonably severe, is helpful, and should be given freely several times a day and for 5 or 10 minutes at each treatment.

LECTURE LV

OBSTETRICS — DIFFICULT PARTURITION

Nature's plan. — When the delivery occurs according to nature's evident plan, the ligaments of the pelvis relax; the water bag appears through the neck of the uterus and finally outside the vagina; the neck and vagina gradually dilate to accommodate the fetus, which presents first the apex of a wedge or cone.

Normal presentations. — We recognize two normal presentations, viz., the anterior, in which the two front feet and the nose appear with the fetus resting upon its sternum, and the posterior, in which the two hind legs and tail appear with the fetus resting on the sternum.

Variations from these produce more or less difficulty in delivery, according as the presentation differs more or less from the normal.

The cause of difficulty may lie with either the mother or fetus, more commonly with the latter.

If the fault lies with the mother, it is usually because of premature delivery; extreme narrowness and closeness of the pelvic outlet; volvulus; deformities of the pelvis (sometimes fracture); tumors within the pelvis; induration or hardening of the uterine neck. Sometimes there is complete closure, and sometimes the trouble is due to excessive accumulations of fat within the pelvis.

If the fault lies with the fetus, it is because of faulty presentations, excessive size, monstrosities, or deformities of the fetus.

Common faulty presentations. — Faulty *anterior* presentations may be: head, or head and neck doubled back; two

feet, or feet and legs back; the neck and one front limb; or the neck and both front limbs back.

Faulty *posterior* presentation may be: one limb back and doubled at the hock or stifle; both limbs back with one flexed at each of these points, or both flexed at the same joint, which may be either hock or stifle.

ASSISTANCE

What may be needed. — There is probably no trouble with farm stock where trained and experienced veterinary assistance is more urgently needed.

Call your veterinarian promptly, if one is available.

If no competent veterinarian is available, then the owner must do the best he can for himself. He may need: plenty of bland oil, *e.g.* linseed; two small window cords with smooth loops in one end of each to loop around limbs; one similar rope with short sharp hook in end to hook in underjaw or eye socket; a pair of small combination pulleys, an embryotomy knife, large trocar and canula, some antiseptic, *e.g.* creolin to be used in 4 per cent solution for hands, instruments, and ropes. These should be kept on hand and ready.

Suggestions. — Do not interfere until the water bag has ruptured spontaneously, unless labor pains have continued for several hours and the water bag does not appear. If the water bag ruptures, in a natural way, and the head, for example, should present without the feet, or the head and one foot, or if one hind foot presents and not the other, or any evidently faulty presentation occurs, then it is time to examine and plan for assistance.

The first thing is to clean and oil the arm and examine carefully to learn the cause of trouble and position of fetus. Then decide what you will do and how. If the condition is such that the delivery will probably be long and tedious, with the patient straining violently, it may rarely be desirable to abate the labor pains with tincture of opium. Other-

wise it will be much better and labor over sooner if the opium be not given. The rectum should also be examined as the hand goes into the vagina, and if distended should also be emptied.

The patient should stand or lie with head downhill. It is usually much easier to operate with the patient standing. Occasionally it is of great advantage to have the patient on one side or the other or on her back for a time. Be patient and not in too great a hurry, and make up your mind that you will succeed, be it ever so difficult. When missing members are secured and ready to pull, pour plenty of oil, or, in the absence of oil, warm water, into the uterus, by means of a funnel and rubber tubing. The parts that will offer friction are probably dry by this time, and should be freely oiled or moistened.

It is frequently necessary to shove the fetus forward into the uterus in order to secure and straighten some missing parts, and for this purpose a smooth broom handle with a short brad in one end will do fairly well; but the hand of the operator must be guarding it, for fear it will slip and tear the mother. This is an accident that must be carefully guarded against on account of probable blood poisoning.

When one part presents, and others are to be secured, or when one has been secured and it is desirable to return it into the uterus to secure another part, always make sure of the progress gained by attaching one of the ropes to the part secured. If the patient cannot be made to stand, always have her on the side opposite the missing part, which thus comes on top. Work between labor pains, and, when all is clear and ready to pull, the assistance should be given moderately and while the mother is straining.

Dropsies. — Sometimes the retarded delivery is due to large accumulations of fluid in the brain cavity (hydrocephalus) of the fetus or within the abdominal cavity (ascites), or to a general accumulation of fluids beneath the skin in the connective tissue and also in the abdominal cavity (general dropsy). In these cases the difficulty may

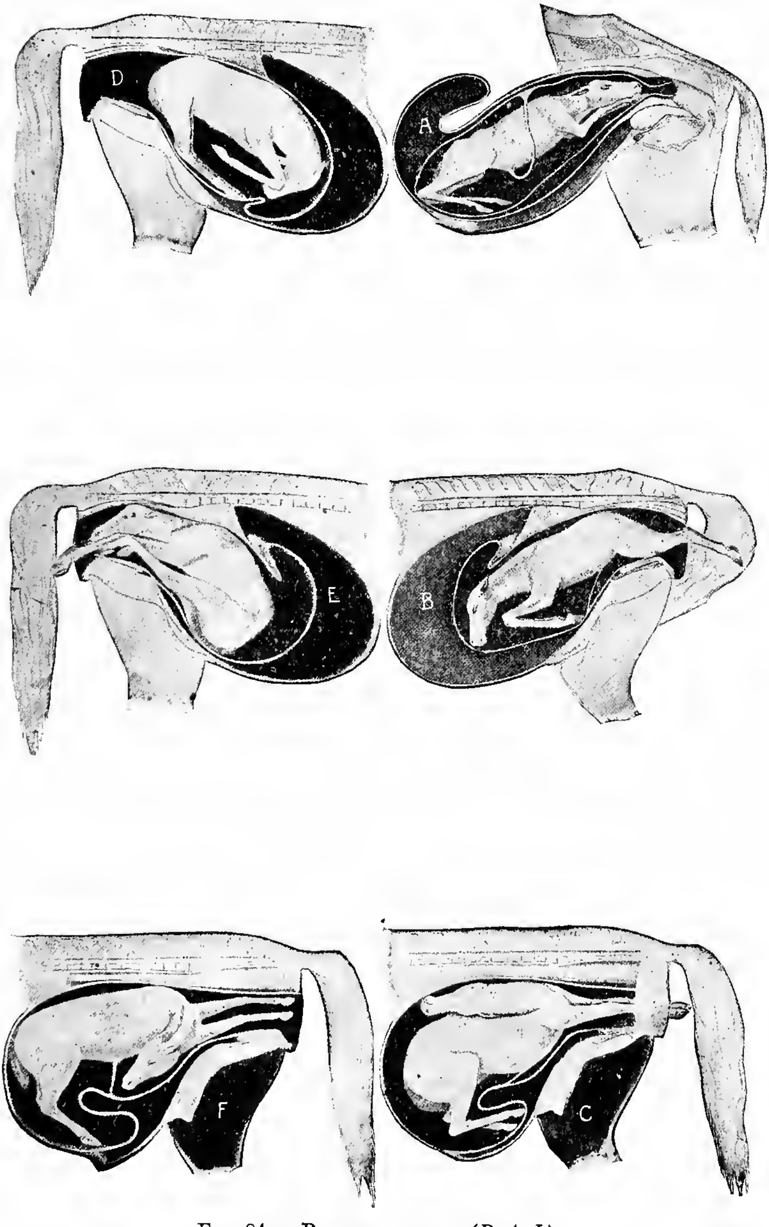

FIG. 84. — PRESENTATIONS. (*B. A. I.*)
A and B, normal; C, D, E, F, common abnormal presentations.

be overcome by removing the fluid by tapping the brain and squeezing the soft bones together, or tapping the abdominal cavity and allowing the fluid to escape. A large trocar attached to rubber tubing is very convenient for this operation.

Gaseous distention. — The difficulty may be due to an excessive accumulation of gases within the body of a dead and decaying fetus, and the obvious treatment is to tap with trocar or knife and allow gas to escape.

Embryotomy. — If it becomes necessary to open the fetal body or remove one or more of the fetal limbs, the operator must observe certain general precautions.

Beware of injuring the maternal parts; be patient and don't be in a hurry.

In case of twins with both presenting at the same time, try to force one back into the uterus and deliver one at a time before attempting dissection, which is usually very tedious, and very exhausting to the operator, and mother as well.

Always save the skin and leave plenty to cover the bones and rough parts of the fetus, and to pull on.

Removing a fore limb. — Take the one that is presenting, attach cord and draw out, as far as possible; slit the skin from as near the top of the scapula as possible to the pastern by means of an embryotomy knife, and dissect the skin loose from the limb, largely by fingers, then cut last the skin around the pastern. Then cut the muscles between the limb and the sternum. By twisting and pulling at the same time the limb can then be removed entire, leaving the skin attached to the shoulder. Do the dissecting with one hand, while the other pulls on the skin outside. The reasons for not removing the skin are plain. The skin gives an object to pull by, and protects the parts of the mother from bones. It also keeps the soft parts of the fetus from rolling up when pressed against the parts of the mother; and finally a dissection is more easily made under than outside the skin.

Removing the head. — If the head can be brought outside the vulva, and there is good reason for removing it (which is not often), cut the skin around the neck, back of the ears, and dissect the skin loose from the muscles by the hand or by a thin spud, using the knife to cut the connective tissue bands that interfere, as far as the operator can reach. Then cut the cord on top of the neck that supports the head, and also the muscles around the vertebræ. Strong pulling and twisting on the head will usually bring away the head and neck, leaving a quantity of skin to cover remaining vertebræ and to assist in pulling.

Removal of the hind limbs. — This is done on the same general principle as for the fore limb. Cut across the pelvic articulation of the limb on the inside so as to sever the ligament which holds the femur strongly to the pelvis. Then slit the skin from this point to the pastern. Dissect the skin loose from the limb, as directed for the fore limb. Then by strong pulling and twisting the limb can be torn loose at this joint.

It is rarely necessary to remove both hind legs. With one out of the way the other can usually be straightened or the body of the fetus removed with the other straightened forward into the uterus. The soft organs may be removed from the body of the fetus if necessary, and then delivery be accomplished.

Cæsarian section. — Removal of the fetus through the flank or median line of the belly is done sometimes, but only as a last resort, more commonly and successfully done with cows and sows than mares. This should only be attempted by a medical expert, unless the plan is to save only the fetus. In the latter case the work must be done rapidly.

LECTURE LVI

COMMON MEDICINES

Common measurements:

Teaspoon holds about 1 dram ($\frac{1}{8}$ oz.).
Tablespoon holds about 4 drams ($\frac{1}{2}$ oz.).
Dessert spoon holds about 2 drams.
Teacup holds about 5 oz.

Giving medicines. — Medicines may be given to domestic animals in the form of liquid drench, ball, in dry powder, or mixed with honey and molasses and smeared on the tongue. In giving a drench remember that a horse's mouth and throat are much more sensitive and more easily burned or irritated than the human. Taste of the medicine before giving, if there is doubt about its being too strong. Powders should be finely pulverized, and must not be caustic or irritating. Balls should be in the shape of a cylinder about 2 inches long and $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in diameter. They should be wrapped in thin paper and oiled. They must be reasonably soft and pliable, and the horse should be offered a swallow of water immediately after giving.

Drenching. — In giving a drench the patient's head must not be held too high, the face should be nearly horizontal, with the nose just a little higher. The operator must not be in a hurry. The medicine should be poured in small quantities on top of the tongue and as far back in the mouth as possible, and the horse should be given plenty of time to swallow. If the horse is obstinate about swallowing, pour a tablespoonful of water into the nose after each time medicine is poured into the mouth. Medicines should never be given through the nose because of danger of choking. For supporting the head to give a drench, a rope may

be tied to the noseband of halter and thrown over the beam — never tied, but held by an assistant. Better still, a cloth loop may be passed around the upper jaw back of the front teeth and through the noseband of the halter in such way that it cannot slip off. This cloth loop is fastened to the overhead rope, which should be held — not tied. Medicines may be given when the patient is lying down, but the operator must be careful not to pour out any medicine when the patient is about to struggle — danger of choking. Take plenty of time.

A bottle of rubber or horn, or a large syringe, is much preferable to a glass bottle, for the latter will readily break, and damage may be done in the mouth by the sharp pieces.

MEDICINES

Aloes. — Cathartic, laxative, or bitter tonic, depending upon the dose given. It is very reliable and satisfactory for horses, less so for ruminants. Very soluble in alcohol and boiling water, imperfectly so in cold water. Usually requires 15 to 20 hours for operation. It is often desirable to combine it with one eighth to one quarter its weight of ginger, and should be given in conjunction with nux vomica in case the bowels are torpid. Large rectal injections of warm water may be given until the physic acts.

Fig. 85. — Holding Horse's Head for Drenching. (*M. H. R.*)

Note cloth loop under noseband.

Doses.—Cattle, 1 to 2 oz.; horses, 2 to 8 drams; sheep, 1 to 2 drams; hogs, 1 to 2 drams.

These doses may be administered with ginger in a ball with lard or molasses, or given in water or sirup as a drench.

Alcohol.[1] — Diffusive stimulant, diuretic, reduces fever, antispasmodic and diaphoretic. Large doses are strongly narcotic. Medicinal doses check spasmodic conditions of involuntary muscle fibers, stimulate the heart and lungs, equalize circulation, and overcome extreme depression. Alcohol is soluble in all proportions in water, and should be diluted at least four times for internal use.

Doses. — Cattle, 2 to 4 oz.; horses, 1 to 2 oz.; sheep, ½ oz.; hogs, ¼ to ½ oz., given in solution and diluted as above.

Boracic acid. — Nonirritating, antiseptic, nonvolatile. It is mainly used externally either in solution (about 3 per cent) or in dry powder as dressing for wounds. Sometimes it is used internally for colts and calves for diarrhea. Boracic acid is soluble in 26 parts cold water, in 3 parts boiling water, or in 6 parts alcohol.

Doses. — Colts and calves take 10 to 30 grains in sirup three times a day.

As an outward application for wounds and sores it may be mixed with half its bulk of iodoform.

Chloroform.[2] — Stimulant, antispasmodic, anodyne, anæsthetic. Its stimulating effect resembles that of alcohol, but is less pronounced and more temporary. Applied externally, it evaporates rapidly and is cooling; but is very irritating when applied externally and prevented from evaporating.

Chloroform is very useful in colic and other spasmodic conditions, given internally with 6 to 8 times its bulk of raw linseed oil, and well shaken.

It is very slightly soluble in water, but dissolves freely in alcohol, ether, or turpentine, and is useful in spasmodic colic given with oil as above.

Doses. — Horses and cattle take 4 to 8 drams repeated every two or three hours, if necessary, till the patient stag-

[1] A diuretic stimulates the kidneys and increases the flow of urine.
A diaphoretic stimulates perspiration.
An antispasmodic relieves crampy conditions, especially of involuntary muscle fibers.

[2] An anodyne, relieves pain.
An anæsthetic removes sensation.

gers. Sheep and hogs take $\frac{1}{2}$ to 1 dram repeated frequently as for horses and cattle.

Carbolic acid. — Deodorizes, and kills germs. In strong solutions it is irritant, caustic, and anæsthetic. Internally it is at first stimulating and afterwards depressing and narcotic, and poisonous in sufficient dose and strength. It is used more commonly for external purposes, especially as a germicide, in 2 to 5 per cent solutions. Dilute solutions kill external parasites. It makes a good wash for foul sores and wounds from which the pus does not drain freely. Carbolic acid is valuable in the treatment of ringworms used as 10 to 15 per cent solution in glycerine or linseed oil.

Carbolic acid is very commonly used as an antiseptic dressing in surgical work (2 to 5 per cent solution). It is usually dispensed from the drug stores as a 95 per cent solution of the crystallized drug.

Dose. — Horses and cattle take internally $\frac{1}{2}$ to 2 drams; sheep and hogs take 10 to 30 drops, administered per mouth as a drench and greatly diluted. It has been used with apparently good results for both after treatment and prevention of infectious abortion in cattle, given as a drench.

Iodoform. — This is used generally for external and local application. It is a deodorizer; it prevents infection of wounds and acts as a local antiseptic. Iodoform is very useful as a dressing for wounds, especially after they have commenced to heal. It may be used alone or mixed with twice its bulk of powdered boracic acid and dusted over the wound surface.

Common lime. — Irritant, neutralizes acids, and is astringent. Saturated solution which is very dilute is useful in diarrheas and indigestions of young animals, and may be given with milk quite freely. Carron oil (limewater and linseed oil in equal parts) is a very useful application for burns. Whitewashing is a satisfactory method of disinfecting and cleaning up outbuildings, including stables.

Doses. — Horses and cattle take 1 to 2 drams of the quicklime; sheep $\frac{1}{4}$ to $\frac{1}{2}$ drams, very greatly diluted in all cases.

LECTURE LVII

COMMON MEDICINES — *Continued*

Raw linseed oil. — Used in veterinary practice to dilute stronger medicines in making liniments and various applications for external use, and internally as a laxative or cathartic, depending upon the dose used. Very safe and but slightly irritating. Good for either horses, cattle, sheep, or swine.

Doses. — Cattle take 2 to 4 pints; horses, 1 to 3 pints; sheep and hogs take $\frac{1}{4}$ to 1 pint.

Rectal injections of warm water may be given after the oil, and it is desirable, if there is sufficient time, to prepare horses by several warm bran mashes before giving the oil.

Corrosive sublimate (bichloride). — A caustic and irritant poison. Used externally as a caustic and antiseptic. Stronger solutions and ointments produce very severe blisters, and frequently destroy the hair follicles.

Its chief use is as a germicide. Cheap and very satisfactory for disinfecting buildings and other purposes where large quantities must be used. Dilute solution destroys lice and itch mites in the proportion of 15 grains to the pint of water. For antiseptic and disinfecting purposes it may be used 4 to 7 grains to the pint.

Epsom salts. — A saline cathartic, causes a large secretion of fluids from the intestinal walls, thus rendering the bowel contents very fluid. It is very satisfactory as a laxative or cathartic for cattle and sheep, not so good for horses. Epsom salts is useful in small doses given to horses in feverish conditions. It is very soluble in water, for it will dissolve in its own weight of warm water, but is insoluble in alcohol.

Doses. — Cattle take for cathartic 1 to 3 pounds; sheep and hogs take $\frac{1}{8}$ to $\frac{1}{4}$ pound. It is frequently desirable to add $\frac{1}{4}$ to $\frac{1}{2}$ these doses of common salt and $\frac{1}{6}$ the total weight of powdered ginger, and give as a drench. It is better to give quite dilute drenches; *e.g.* the cow's dose should be dissolved in 2 to 3 pints of water, and the others in proportion.

Sodium chloride (common salt). — An essential article of food, restorative and antiseptic. Very large doses are

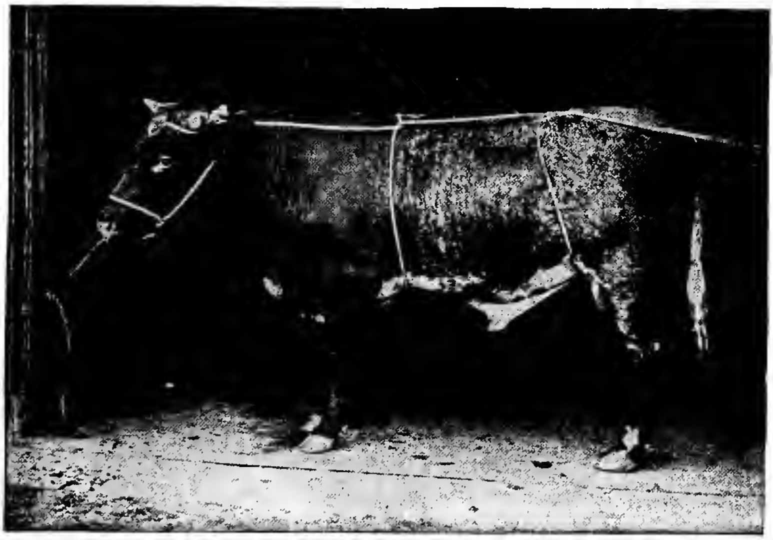

Fig. 86. — To Throw Cattle. (*M. H. R.*)

Pull straight back on the rope.

cathartic and more or less irritating. For grown cattle and sheep in good strength salt is a very useful cathartic. Salt is more commonly combined with other saline cathartics. It is useful as a throat wash in certain sore throats, diluted to 5 per cent solution in water.

Sodium hyposulphite and sodium sulphite. — Antiseptic and deodorant; especially valuable for internal administration, to check fermentation and septic processes in the stomach and intestines, and therefore valuable in conditions

of diarrhea, indigestions, and hoven or bloat. It is also useful in small doses to control feverish conditions. Both the sulphite and the hyposulphite are readily soluble in water.

Doses. — Horses and cattle take of the sulphite 8 to 10 oz.; sheep and swine take 4 to 8 drams. The doses of hyposulphite are much smaller — about half as large as for the sulphite. These doses are to be given as drenches, well diluted, and repeated three times daily. Smaller doses may be given every half hour in cases of bloat.

Saltpeter (nitrate of potash). — Mildly antiseptic, and has slight cathartic effect. It is diuretic; it increases the secretion from skin and bronchial tubes; is alterative and febrifuge, and useful in the treatment of all classes of animals. Saltpeter is useful for external cooling effect when dissolved in water with sal ammoniac. For alterative and febrifuge effect it is given in about half the doses that are given to stimulate the kidneys.

Saltpeter is very soluble in water, warm or cold.

Doses. — Cattle and horses for diuretic effect, $\frac{1}{2}$ to 2 oz.; sheep and swine, $\frac{1}{2}$ to 2 drams. These doses are given in the drinking water or as a drench. Not caustic.

Sweet spirit of niter. — Stimulant much like alcohol or ether; it is antispasmodic and increases the excretion from skin, lungs, and kidneys. Very large doses are narcotic. It is very useful in cases of spasmodic colic and tympanites, and is a convenient heart stimulant.

Doses. — As a stimulant and antispasmodic, horses and cattle take 2 to 4 oz.; hogs 2 to 4 drams. It is decomposed by water, and should not be mixed with other medicines until just before giving. It is given as a drench with water or in sirup. As an antispasmodic it may be given to advantage with either opium or chloral hydrate.

Oil of turpentine (common turpentine). — Stimulant, antiseptic, and destroys parasites, both external and internal. It is readily absorbed when swallowed, and is excreted by the lungs, skin, and kidneys. Overdoses irritate the mucous

membrane of these organs. For medicinal purposes it is used in indigestion, certain conditions of diarrhea and tympanites (bloating); a very useful medicine in these conditions and one that is usually at hand. It is slightly soluble in water, quite soluble in ether or alcohol or linseed oil.

Doses. — Horses and cattle, as stimulant and antispasmodic, take 1 to 2 oz. two or three times a day for stimulating effect upon mucous membranes of the bronchial tubes, skin, or kidneys. The dose for sheep and swine should be about $\frac{1}{6}$ of these quantities.

Opium. — Medicinal doses relieve pain and spasmodic conditions, reduce congestion and inflammation; check intestinal secretion and peristaltic movements; and with some animals produce sleep. The various preparations of opium are used in medicine for the purpose of relieving pain, perhaps more than any other agent. Opium is a typical anodyne (pain reliever), but there are very many conditions that arise in practice under which it should never be given, which it is not thought practical to explain in this short lecture further than that the person who is giving opium to any domestic animal must not forget that it checks intestinal secretion and peristaltic movements of the intestine, and in this way may cause constipation at just the time when the reverse condition is desired.

Dose	Horses	Cattle	Sheep	Hogs
Crude opium . . .	1–2 drs.	2–4 drs.	10–40 grs.	10–40 grs.
Morphine sulphate .	3–5 grs.	3–8 grs.	½– 2 grs.	½– 2 grs.
Tincture opium (Laudanum)	1–2 ozs.	1–3 ozs.	2– 6 drs.	2– 6 drs.

The tincture should be diluted with water or sirup the same as for alcohol.

Morphine is an active principle of opium, and shows all the essential physiological properties of the crude drug. Cattle and sheep take very large doses. Morphine and

various preparations of opium are frequently employed with advantage in spasmodic colic, and may be combined with stimulants and anodynes like ether, sweet spirit of niter, or chloral hydrate. It is usually advisable to give a mild laxative soon after the opium operates.

INDEX